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ART BULLETIN NUMBER FOUR

PROBLEMS
IN
PERSPECTIVE

EAST BLOCK, PARLIAMENT BUILDINGS, TORONTO

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DEPARTMENT OF EDUCATION, ONTARIO

TORONTO
1928

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It is the hope of the Department of Education that the matter and the illustrations are sufficiently clear and simple to enable the individual to work out the elements of the subject himself.

Messrs. Ralph McMullen, H. McCrea, Herbert Palmer, Frank Carmichael, Arthur Lismer, Alfred Howell, and S. W. Perry have all had some part in the preparation of these Bulletins.

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Bulletins previously issued:

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Drawing - - - - - - Number Two
Roman Lettering - - - Number Three

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PROBLEMS IN PERSPECTIVE

SCOPE OF THIS BULLETIN

In Art Bulletin Number One the development and use of perspective diagrams were explained, and a few of the simpler and commoner exercises were illustrated—such as students just commencing the study of perspective might find useful.

In this Bulletin there will be considered some of the more difficult problems connected with pictorial rendering from plans and elevations, with the perspective of shadows and reflections, and with other perspective problems which often puzzle the student.

It is not intended that these courses shall be exhaustive. A minimum of the mechanical side of perspective has been given —only sufficient to suggest to the young artist what he should know, and wherein he should be careful in his sketching of objects or scenes showing distance.

ABBREVIATIONS USED IN PERSPECTIVE

(See Bulletin One, page 11.)

1. The Picture Plane—(P.P.)
2. The Ground Line (G.L.), or Base Line (B.L.), of the Picture Plane
3. Spectator's Point (S.P.)
4. Line of Vision (L.V.)
5. Centre of Vision (C.V.)
6. Horizon Line (H.L.), or Eye Level (E.L.)
7. Height (H.)
8. Vanishing Point (V.P.)
9. Measuring Point (M.P.)

VALUE OF THIS TRAINING

The artist, or designer, is often called upon to compose, or design, pictures, and the architectural draughtsman must project from plans or from specifications a pictorial representation of a building, or part of a building, or an object. One who has had no training in perspective, or the laws which govern the appearance of objects, would be at a loss to proceed to such an undertaking with courage or with a hope of success.

APPEARANCE OF THE SAME ANGLE AT DIFFERENT LEVELS AND AT DIFFERENT POINTS ON THESE LEVELS

Teachers of perspective have found that one of the greatest difficulties experienced by beginners is the construction of an object on the ground plane, or at different levels above the ground plane, or above the horizon, or at any point on the selected plane to the right or left of the line of direction, especially if the object is to be situated in the drawing at a distance back of the ground line, or picture plane.

As a simple preliminary problem, let us consider the placing of a right angle before us on the ground (see the right angle at S.P. in Figure 1). If we follow the left side of this right angle till it reaches the horizon, we find the vanishing point to the left (L.V.P.). If we follow the right side of this right angle to the horizon, we find the second vanishing point to the right (R.V.P.).

If the point A in Figure 1 be taken on the selected ground line (or P.P.), and A be joined with L.V.P. and R.V.P., the inclosed angle represents the same right angle as at S.P. situated horizontally to the left of the line of direction.

It does not matter how high or low this angle is placed (on a chair, or on a table, or on the ground) in relation to the spectator; if that position is parallel with the ground plane, the same procedure will find the same vanishing points on the same horizon line.

If the angle is placed above the eye level, or horizon line, the same V.P's. will be used, only the lines will slant or converge downward to the horizon at the same points.

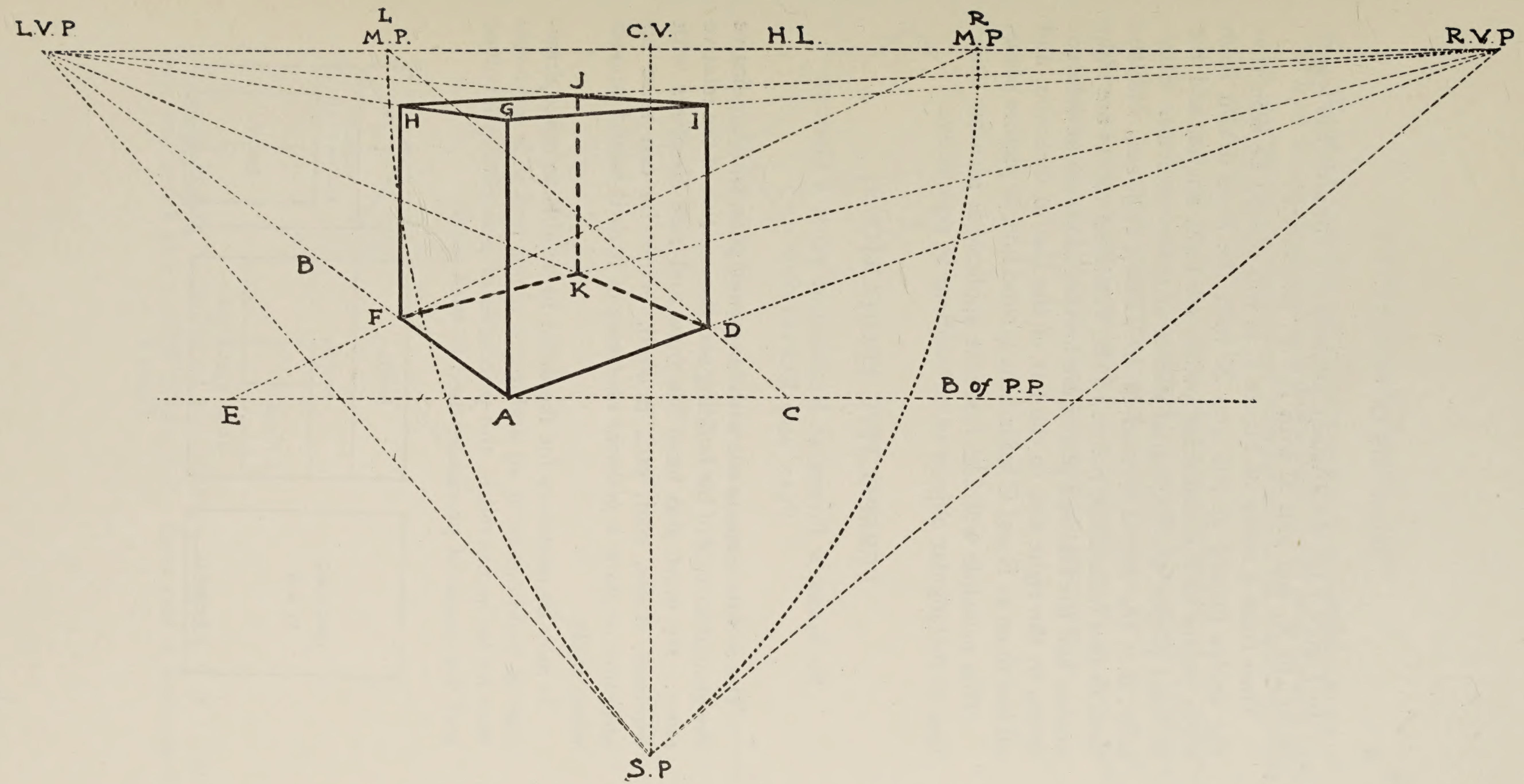

Figure 1

In Figure 1 let the student produce AG upwards the length of AG to X, and join X with L.V.P. and R.V.P.

Then from a study of Figure 1, it will readily be seen that the angles formed at AG and X with the lines drawn from these points to the vanishing points are right angles, and the inclosed planes are horizontal planes at different levels. Similarly, that the angles formed at EC, FDK, HIJ, etc., with the lines drawn from these points to the vanishing points are right angles, and the inclosed planes are horizontal planes at different levels to the right and to the left of the line of direction, and all but those at E and C behind the ground line, or picture plane.

This principle will find frequent application in most drawings of rectangular objects or of buildings in perspective.

PERSPECTIVE PROJECTIONS

To Make a Pictorial Rendering from a Ground Plan and Elevations

The architect starts out with his *ground plan*, which indicates the ground surface of his building and the position of the relative parts. He must also have his *front* and *side elevations* with windows, doors, roof, etc., marked, before he can raise his structure or show a *pictorial rendering* of it as it would appear when built.

It may be necessary for the artist to be able to make drawings of buildings from an architect's plans, and it is advisable that he be instructed in the principles of perspective involved and the course of procedure used in such work.

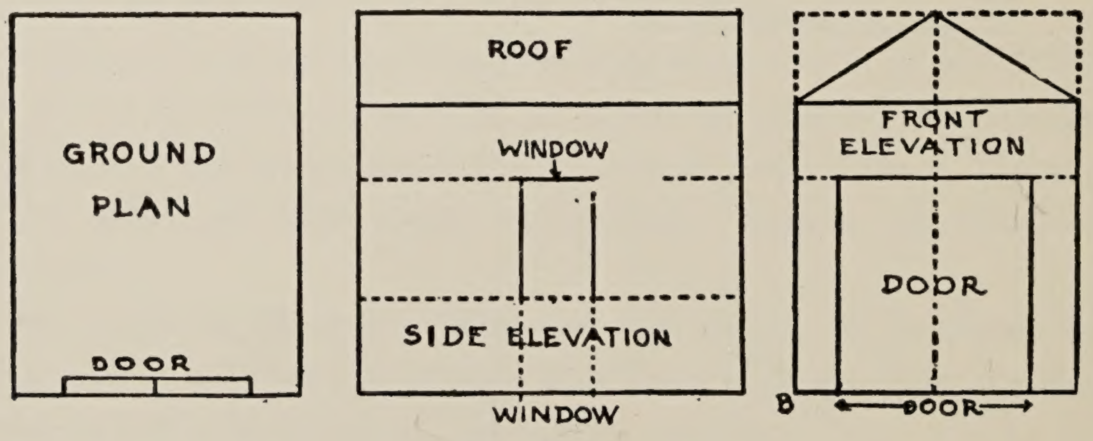

Figure 2

We shall simplify this subject as much as possible, so as not to load the student with too many facts, using only those which are absolutely necessary and without which he cannot succeed in this kind of work.

Figure 2 shows the ground plan and side and front elevations of a simple garage. The correct procedure in making a drawing of this building, using the plans, is as follows: First decide on the position or angle at which the building is to be seen and place the ground plan in that position on your paper.

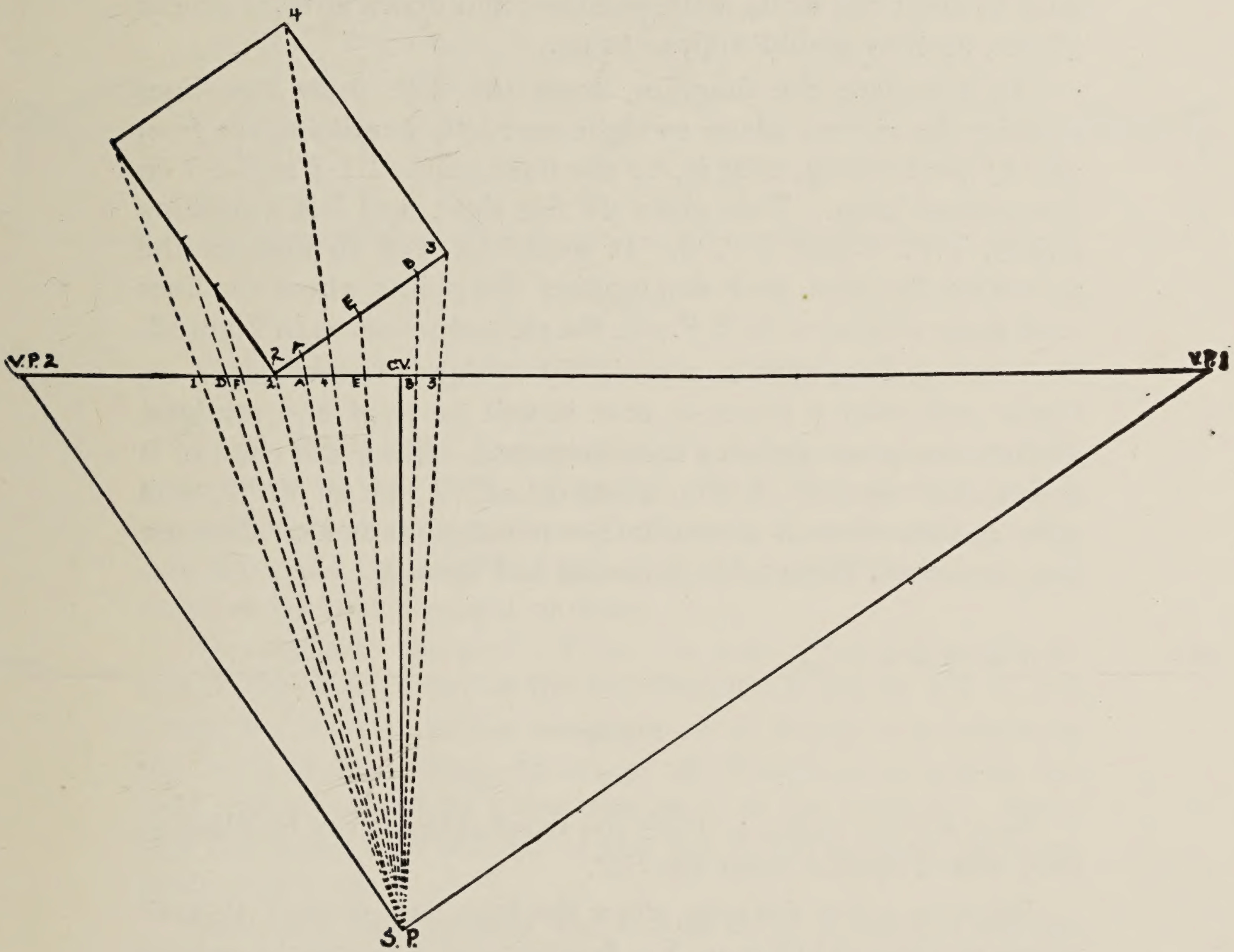

Figure 3

As in Figure 3, decide on the distance at which it is to be seen and mark the station point, S.P.; then rule a horizontal line touching the near corner of the ground plan, which represents the base line of the picture plane, P.P. From the station point rule a perpendicular line to the picture plane, which gives you the centre of vision, C.V. on the P.P.

From the corners of the plan and the door and window points, rule lines to the S.P. In this way the dimensions of the ground plan and also of the doors and windows are marked on the base line of the P.P.

So far we have only the appearance of the actual base dimensions of our building as it rests on the ground. We have next to erect the walls, with windows and doors in their proper places, as they would appear to us.

To complete the diagram, from the S.P. draw two lines cutting the picture plane to right and left, *parallel to the front side of the building*, that is, to the lines marked 1-2 and 2-3 on the ground plan. This gives us the right and left vanishing points, V.P. 1 and V.P. 2. It would be well to number the points on the plan, and also number the points where the lines from these points to the S.P. cut the picture plane, as in Figure 3.

Now take the edge of a perfectly straight piece of paper, or, better still, fold a piece so that it will be rigid and straight. Use this for your scale of measurements. Place the edge of it beside the base line of the picture plane, V.P.1 to V.P.2, and upon it tick off each dimension, or point, as found on the base line, and mark them with letters as in Figure 4.

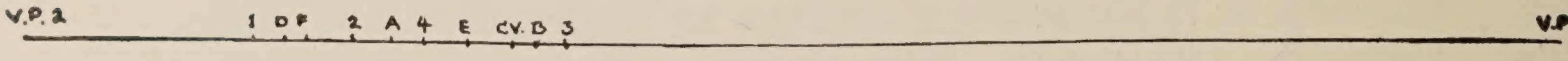

Figure 4

Now we are ready to raise the front sides of the building as they would appear from the S.P.

Starting a new drawing, draw the base line of the P.P. with points marked as in Figure 5. At the point 2, where the nearest corner of the building would touch the P.P., raise a vertical line the height of your building. See line A-B on the elevation plan of Figure 2. Mark the height of the side wall on this line at the point G.

Now, to decide where the horizon line, or eye level, would be on this drawing, we must consider whether the building is to be seen from a position when standing in a level plane or from a height, etc.

If we are standing on a level, horizontal plane, the horizon would be where our eye would be if we were standing at the corner of the building. This would be about two-thirds of the height of the door frame. At this height draw the horizontal line representing the horizon.

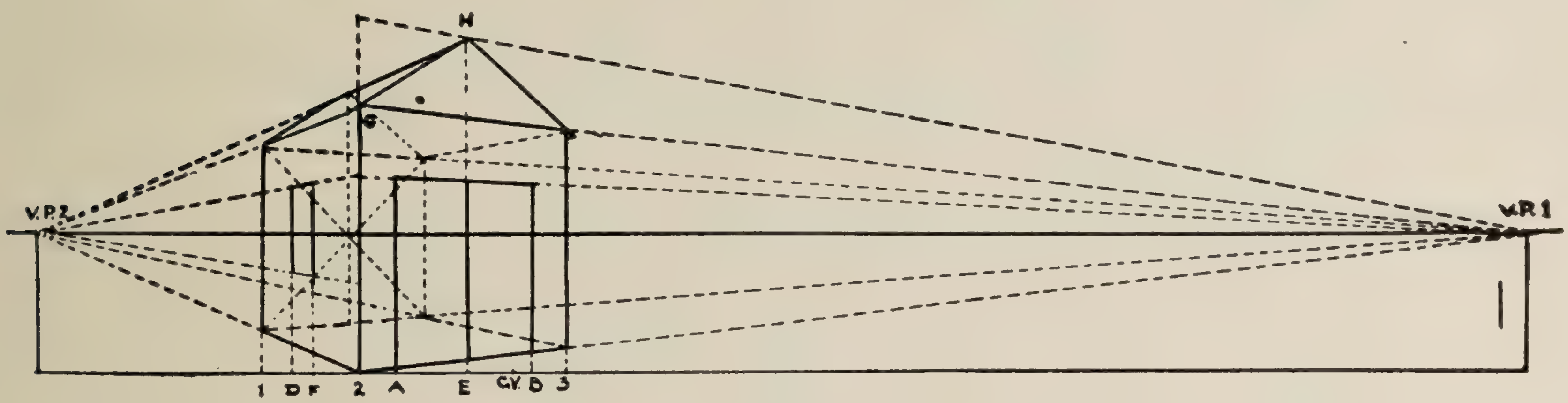

Figure 5

Figure 5. Raise the V.P's. from the ground line to the horizon.

From the nearest corner of the building, points 2 and G, draw lines to the V.P's. Directly above the points 1 and 3, draw the perpendicular lines of the ends of the building. We now have the frame of the building as it would appear in perspective without the roof or doors.

To construct the roof. From the top of the perpendicular line of the near corner of the building run a line to the V.P.1. From the point E, which is the centre of the door or centre of the front of the garage, erect a perpendicular cutting this line —at this point will be found the point of the gable H. Next, join this point with the top of the side walls, forming the front gable of the roof.

Next, the back gable of the roof is to be drawn. Find the centre of the back of the building as indicated by diagonal lines on the Figure, and run a perpendicular line cutting the line from the point H to V.P.2. This will give the ridge pole on the top line of the roof.

To place windows and doors, mark the height on the corner touching the ground line, and join these points to the V.P's. as shown in Figure 5. Now erect perpendicular lines from the points D, F, A, and B, already marked on the ground line. This will give the side boundaries. These steps will be apparent in Figure 5.

When there are many doors and windows, the number of lines and points may be confusing, so it is well to construct the building first on the drawing, then make a tracing of the points of doors and windows on a separate piece of tracing paper, tracing from the drawing.

When these doors and windows have been found, they may be punched through to the drawing with pin points and afterward drawn on the original drawing. This is necessary only on complicated plans.

In the method explained we do not need to use measuring points, diagrams, etc., to find the length of a receding line, as we did in Figure 1. (See also Figure 11 in *Art Bulletin Number One.*) We use the measurements on the ground line as obtained in Figure 3, and raise a vertical line from each point and so cut off each receding line at the proper place. It does not matter how high the building is or how many doors or windows there are, the same method can be used.

How to Place a Tower or Chimney at the Far Corner of a Building, Raising it from Its Base on the Ground Plane

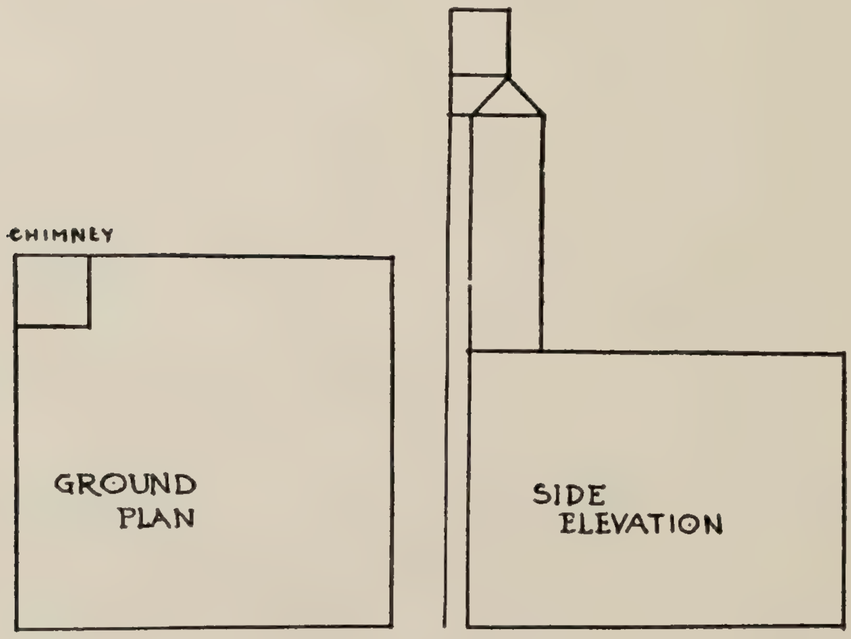

Figure 6

Figure 6 shows the ground plan and side elevation indicating the height of the tower.

Figure 7 shows the ground plan in position with the tower. The points are marked on the base line of the P.P. Note how the centre of the tower is marked on the ground line at O by a line carried parallel to the side of the building till it cuts the P.P.

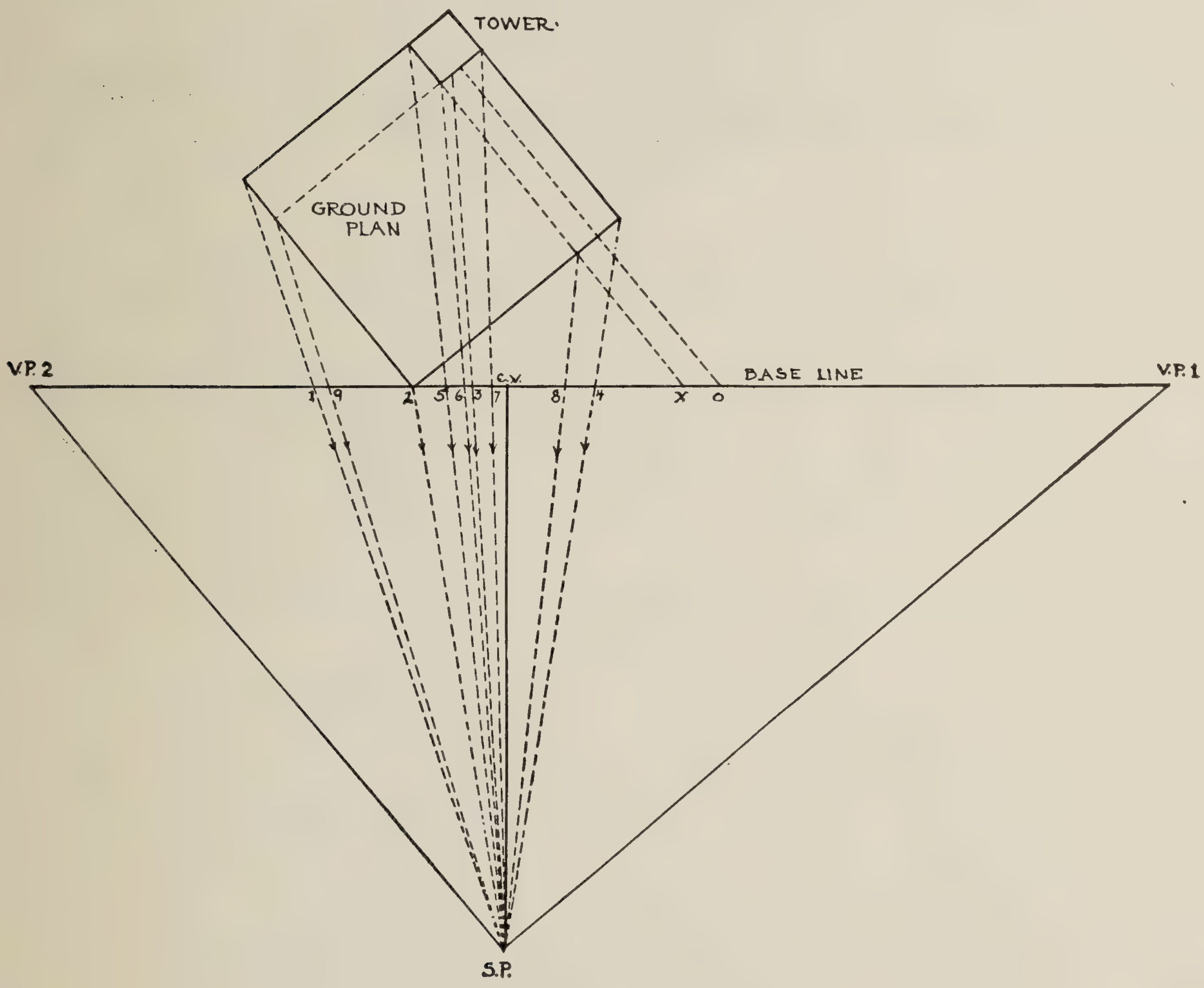

Figure 7

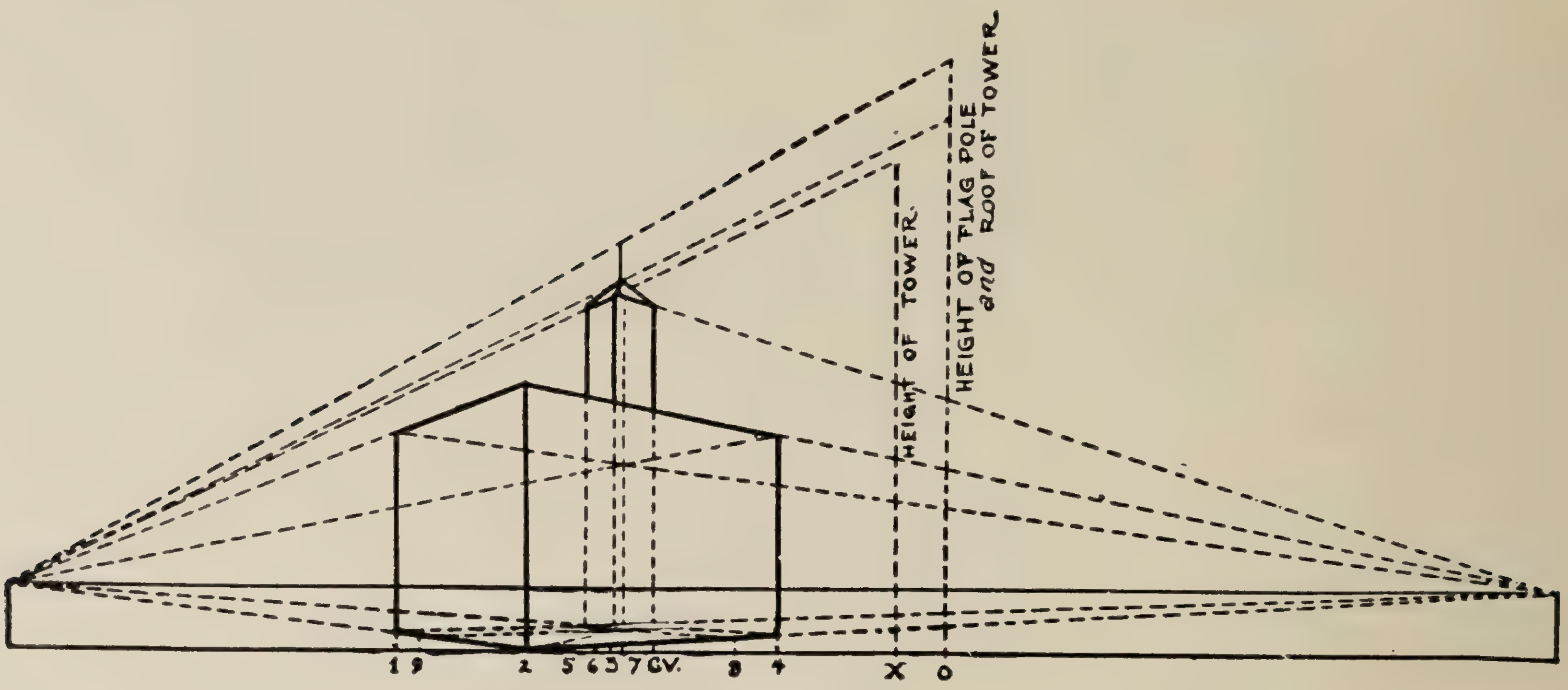

Figure 8

A similar line from the near corner of the tower is carried to X. In raising the building (see Figure 8), carry out the same procedure as in Figure 5. From the points X and O a perpendicular line is raised to find the height of the flagpole and the tower. On account of the corner of the tower being nearer than the point in the centre under the flagpole from the point O, the height of the roof of the tower is measured from the same line O as the flagpole, as it is directly beneath it.

To Draw a Building or a Room One Face of Which is Parallel to the Picture Plane

In the previous diagrams the building has been shown at an angle. To draw the building with one face parallel to the P.P. the procedure is much the same. If the front of the building is particularly interesting, the building is sometimes drawn in this position. This position is often used for drawings of interiors, gardens, courts, etc.

Figure 9 is the ground plan of a one-room house, from which we will make a drawing as it would appear inside, parallel to the picture plane. The height is taken as shown in Figure 10. The dark area to the right on the floor is the space where a flue would be erected for a grate. The front of the building is touching the picture plane.

As in Figure 11, first erect the front elevation at 1, 2, A and B, on the P.P., then decide on the height of the horizon line. In this case it is rather higher than it would be if we were standing on the ground. Draw the horizon. From C.V. on the P.P., draw a perpendicular line to the horizon line at the V.P., and from A, B, etc., draw the parallel, horizontal, receding lines to the V.P.

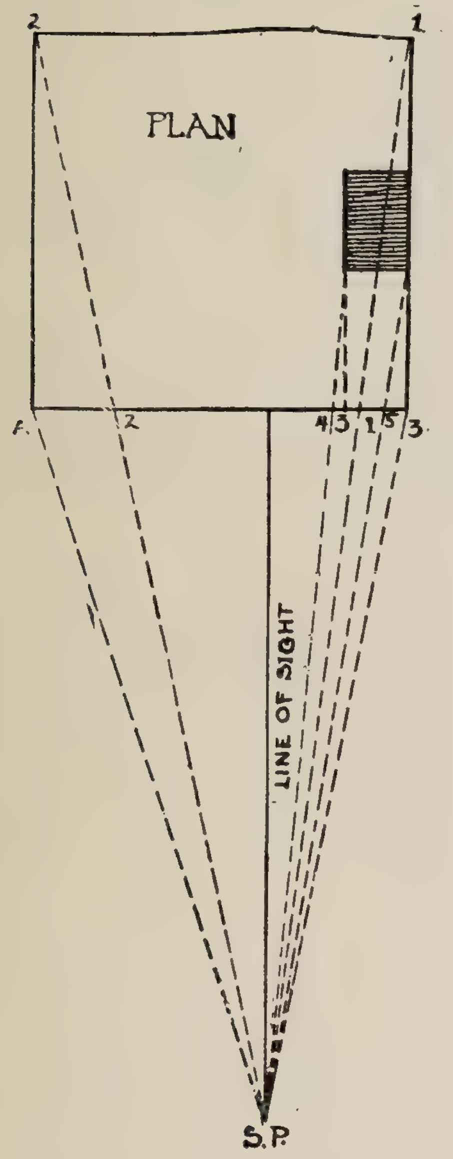

Figure 9

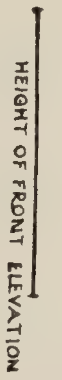

Figure 10

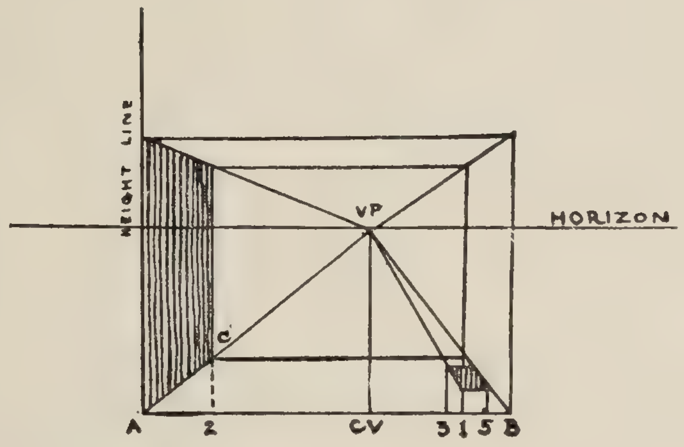

Figure 11

To find the depth of the walls, at the point 2, erect a perpendicular line till it cuts the line A-V.P. This will be the far corner of the left wall. Draw two lines from this point, one perpendicular, till it cuts the upper receding line, which will give the depth of the left wall, the other line horizontal, parallel to the P.P., which will give the depth of the floor area. Carry out the other wall and ceiling on the same principle, as illustrated in the Figure.

If we have the problem of laying out a room with furniture, rugs, etc., placed in given positions as shown on a ground plan, and pictures, doors, windows, and height of furniture on the side and front elevations, we could make a drawing following the same laws.

THE PERSPECTIVE OF CAST SHADOWS

Value of this Study

The subject of drawing shadows and the principles of perspective governing their shapes is one that is often overlooked in the teaching of drawing, and at first sight might be considered of little importance.

Nevertheless, it is quite important that the artist should realize the underlying laws of shadow perspective, and be able to use his shadows to advantage in pictorial composition, and not be forced through lack of knowledge to shirk this important feature in his work.

There are certain dramatic subjects in figure composition in which shadows cast on the wall may have a more telling effect than the figures themselves. The shape of a well-expressed shadow is often a great aid in suggesting the form of an object. In other cases it may be the chief feature in expressing the form or surface of the plane on which it is cast.

Telling the Time of Day

The time of day is often clearly indicated in a picture by the length of the shadows. Note how at midday the shadows of trees, animals, etc., in the field are almost directly beneath them, while in the late afternoon they make long-drawn-out streaks behind, before, or beside them.

Sunlight and Artificial Light

In considering the perspective of cast shadows, we must note the differences between (*a*) the shadows cast by objects coming between the sun and the surface receiving the shadow, and (*b*) those cast by objects coming between an artificial light and the receiving surface.

Owing to the distance of the sun the edges of the shadows cast on a level plane will converge in accordance with the laws of perspective to a point on the horizon. (See Figures 13 and 16.)

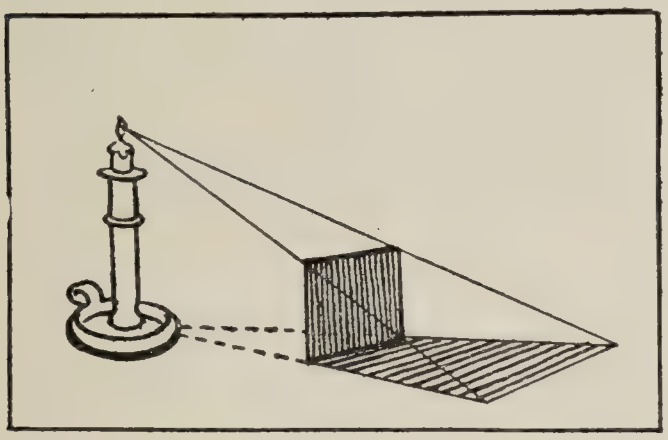

Figure 12

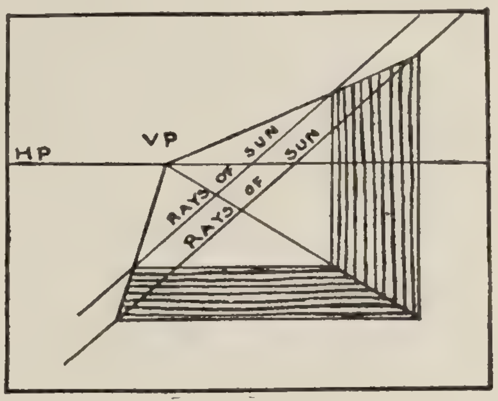

Figure 13

The vanishing point of shadows cast on a level plane by an object upon which an artificial light is shining, will be found at a point directly beneath the light. (See Figure 12.)

If the sun were shining upon an object placed between the spectator and it, the right and left edges of the cast shadows would converge to a point on the horizon directly under the sun. (See Figure 14.)

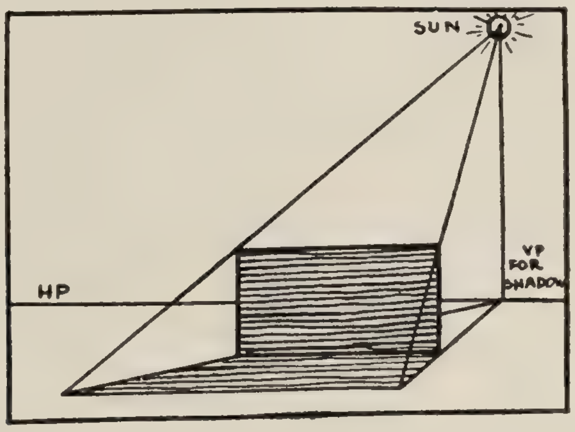

Figure 14

It will be observed that there is a difference between the shapes of the shadows cast from these two sources of light, those from the artificial light being much more distorted than those from the sun, since the distance of each from the object casting the shadow varies so enormously. (Compare the cast

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NOTE.—For the meanings of terms and abbreviations used, and for the construction of the angular perspective diagram, consult ***Art Bulletin Number One***, pages **11-15**, and Figures 10 and 11, pages 15-19.

shadows in Figures 12 and 13.) When the sun is to the right or left, and not behind or before the object casting the shadow, the lines indicating the direction of its rays will be parallel, and the shadows will be short or long according to the height of the sun. The higher the sun, the shorter will be the shadow.

An experimental study of the relationship of the sun on an artificial light, to an intervening object and its cast shadow will establish the foregoing and other laws which the young artist should know.

The student will be the better able to appreciate and apply the laws of perspective to shadows (and later to reflections) if he carefully works out the following problem:

Problem on the Perspective of Cast Shadows

Let us assume that the distance from S.P. to C.V. is represented by a line 5″ long, that the height of the spectator—from the G.L. to the E.L.—is represented by a line 2½″ long, that a cube 2″ to an edge is situated so as to be touching the G.L. ½″ to right of L.V. and making an angle of 60° at S.P. to the left.

1. Construct and letter the angular perspective diagram, and draw the required cube. (See Note above and Figure 15.)

2. Show the position of the shadow cast by this cube when the sun at an altitude of 45° is shining upon it directly from the left.

   Since the sun's rays are parallel R^1a will reach the ground plane at a^1, and *Aa* will thus be represented by the line Aa^1.

   Similarly, R^2b and R^3d will be represented on the ground plane by a^1b^1 and b^1d^1, and D*d* by Dd^1. Then the shaded part of the cube represents the visible part in shade, and the horizontal shading represents the shape of the visible position of the cast shadow.

If the sun's altitude were increased, the points a^1, b^1, d^1, would be nearer the cube, and the cast shadow would appear shorter; if its altitude were decreased, these points would recede from the cube, and the cast shadow would appear longer; if, instead of being directly to the left, the sun were somewhat to

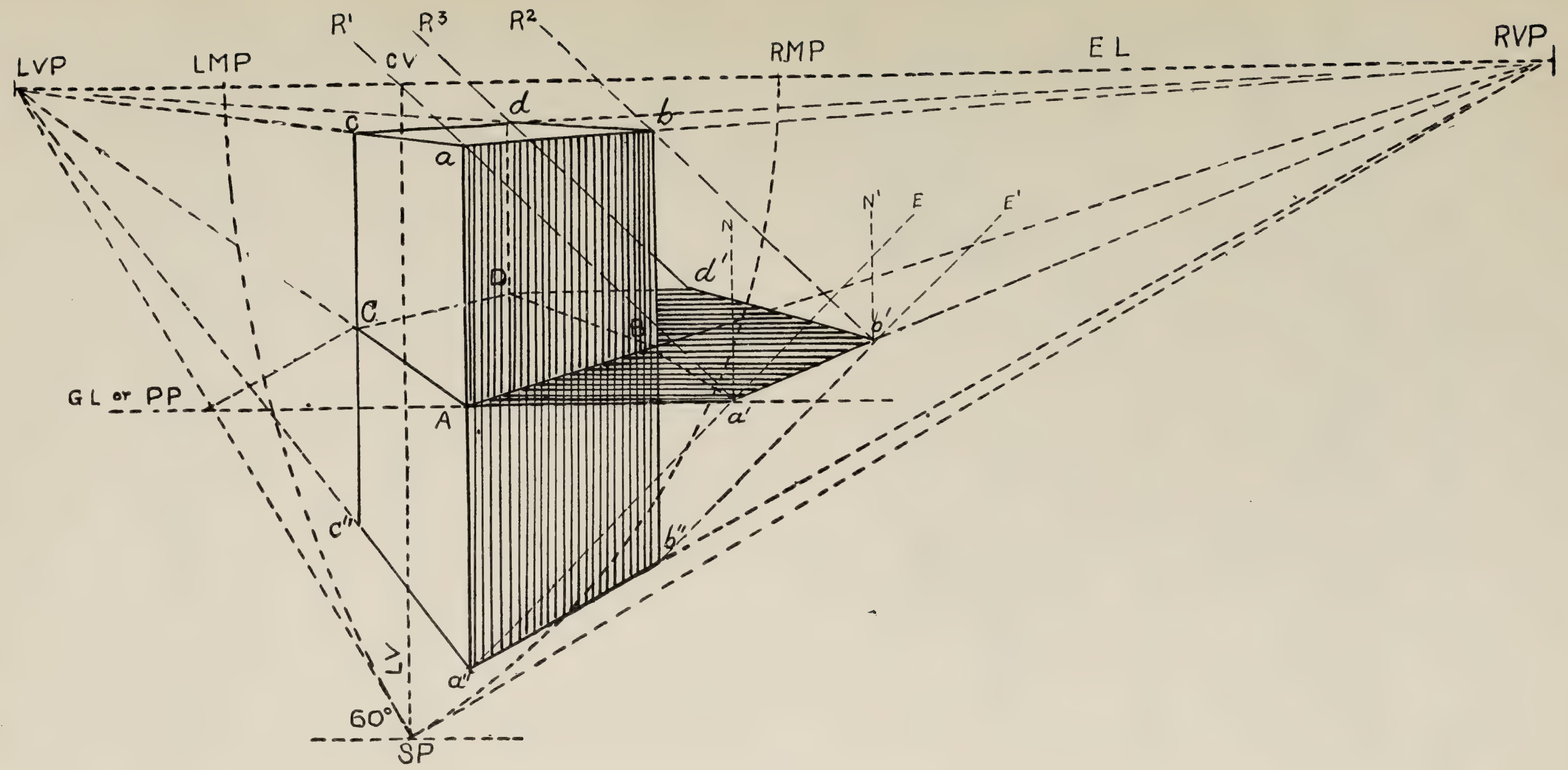

R'
R³
R²
LVP
LMP
CV
RMP
EL
RVP
c
d
b
a
N
N'
E
E'
D
d'
C
B
b'
GL or PP
A
a'
c''
b''
LV
a''
60°
SP

Figure 15

the front, or to the back, these points, obviously, would be found farther behind, or farther in front of the G.L. Thus the outline of the cast shadow might quite easily be estimated.

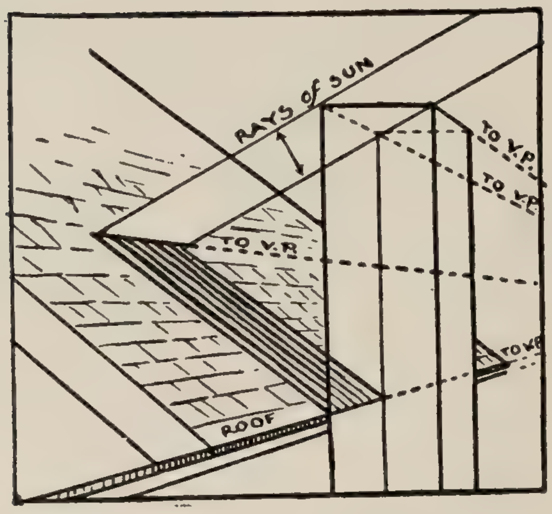


Figure 16

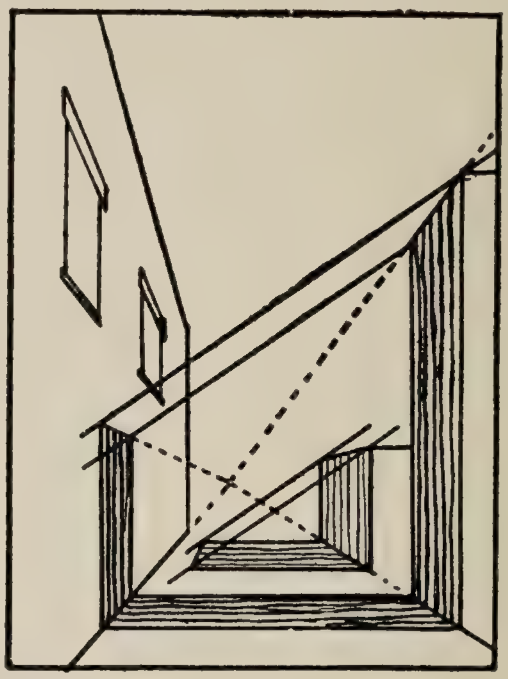


Figure 17

Cast Shadow on an Oblique Surface

In Figure 16 there is shown the shadow of a chimney at the edge of a roof when the sun is to the right. Observe that the rays are parallel.

Cast Shadow on a Horizontal and a Vertical Plane

In Figure 17 will be found an example of a shadow cast on a horizontal and a vertical plane. The parallel rays of the sun shining from the right determine the end of the shadow on the upright wall to the left. Observe that the receding ends of the vertical and horizontal shadow converge to the C.V. in the E.L.

Cast Shadow when the Sun is in Front of the Spectator

When the sun is in front of the spectator and the plane receiving the shadow is level, the rays of the sun will not be parallel, as when the sun is at either side, but will radiate. The side lines of the shadow will converge to a V.P. at a point on the horizon directly under the sun. (See Figure 14.)

If the plane on which the object stands is inclining or declining (up hill, or down hill), the lines of the sun's rays passing over the object which casts the shadow will fix the limits of the shadow; but the side lines of the shadow will converge to the uphill or downhill V.P. directly under the sun. (See Figure 18.)

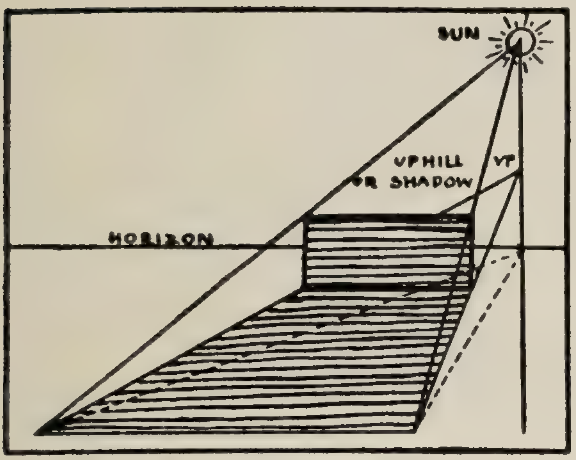


Figure 18

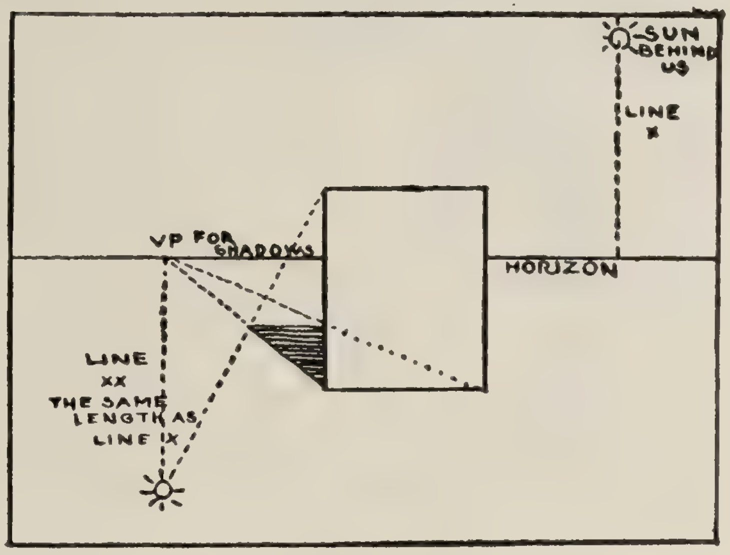


Figure 19

Cast Shadow When the Sun is Behind the Spectator

When the sun is behind the spectator, it is not possible to draw the rays from it, so the following device must be adopted. The sun is placed below the horizon as far as it is above it, and immediately below the V.P. of the shadow. Figure 19 shows a vertical wall-like plane a little to one side. The line running from this second sun below the horizon to the top of the wall will fix the end of the shadow, by intersecting one of the converging side lines of the shadow.

With the wall standing on an ascending or descending plane, the V.P. would be raised or lowered according to the angle of the plane, and would be found on the same vertical line above or below the V.P The sun, of course, will be below the horizon as before.

Cast Shadows Upon an Uneven Surface

In Figure 20 a shadow cast from a straight edge above upon a vertical column assumes the curve of the column in a slanting direction.

In Figure 21 the grassy horizontal plane and the overlapping boards of the vertical plane receiving the shadow show much unevenness along the edges of the shadow cast by the post.

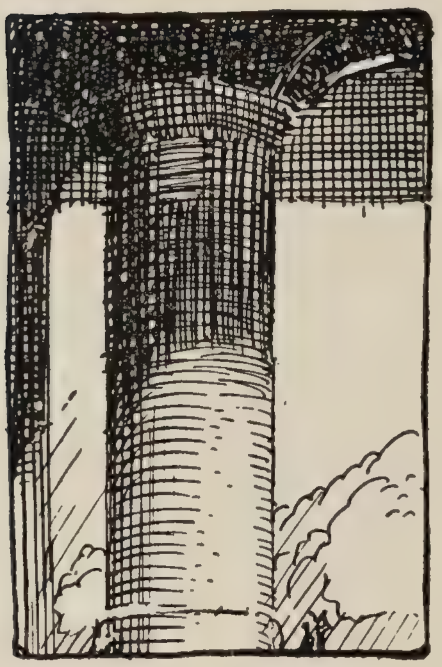


Figure 20

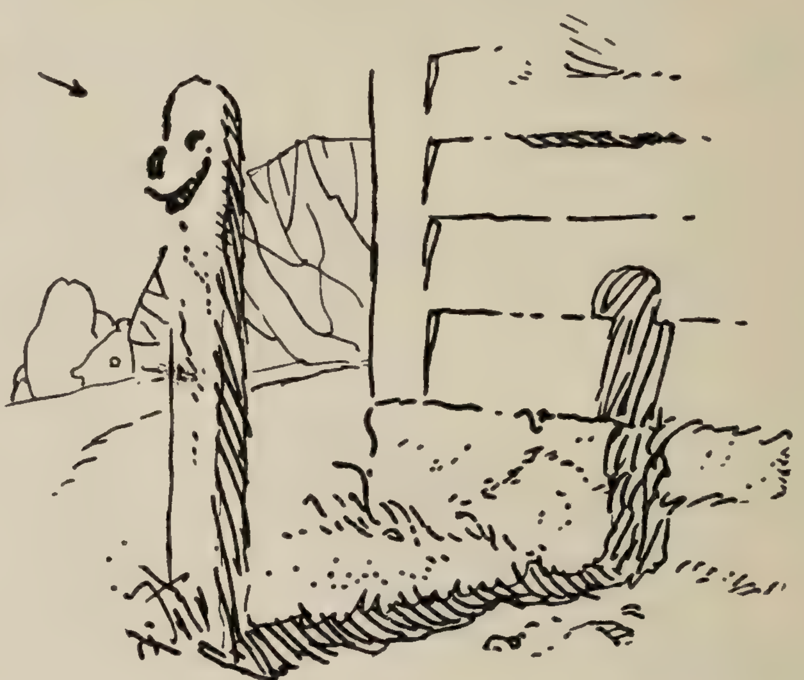


Figure 21

Very simple objects have been used to illustrate the principles of the perspective of shadows. The application of these principles will ensure the correct shape of the cast shadow of any object.

PERSPECTIVE OF REFLECTIONS

Explanatory Problem

To have a reflection an object must be situated before or above a reflecting surface, as a mirror, a polished table, or water. If we examine Figure 15, we see that the sun's ray aa' descending over ABba strikes a polished surface, of which the G.L. is a section at a' and is reflected upward to E (the position of the eye of the spectator, which may be anywhere along $a''a'$ produced). If Ea' be continued in a straight line downward until it meets aA produced at a'', where the eye sees the point a reflected, then Aa'' shall be equal in length to Aa. And if the normal Na' be erected perpendicular to the surface at a', the *incident* ray aa' and the *reflected* ray Ea' will make with the *normal* Na' the two angles N$a'a$ and Na'E, which are equal and are called, respectively, the *angle of incidence* and the *angle of reflection.* The length of B*b* and B*b*″ will be found to be equal in the same way, or *b*″ may be found by joining *a*″ with the R.V.P., as *a*″*b*″ is parallel to *ab* and, therefore, converge to the same point.

For a more complete consideration of reflections, the student is referred to the *Ontario High School Physics*, pp. 304-5.

We are now prepared to state a few laws of reflection for use in future drawings.

1. The angle of incidence is equal to the angle of reflection.

2. The incident ray, the reflected ray, and the normal to the surface are all in one plane. For example, if we desired to find the length of B*b*″ in a similar way to that used to find the length of A*a*″, we should erect at *b*′ a normal perpendicular to the surface B*b*′ so that E′*b*′N′ is equal to *bb*′N′. Then E′*b*′ produced would meet *b*B produced at *b*″, and B*b*″ would be equal to B*b*.

If *a*″ be now connected with the L.V.P. and *c*C be produced to *c*″, we shall have the complete reflection of the cube erected upon C A B D, as seen by the spectator facing the C.V., and the shaded side AB*ba* will be seen reflected a little lighter, as in AB*b*″*a*″.

EASY ILLUSTRATIONS OF THE PERSPECTIVE LAWS GOVERNING REFLECTIONS

A pole standing in the water duplicates itself upside down —Figure 22. The receding lines in the reflection tend to the same V.P. as those of the object itself—lines 1-2 and 3-4 shown in Figure 23.

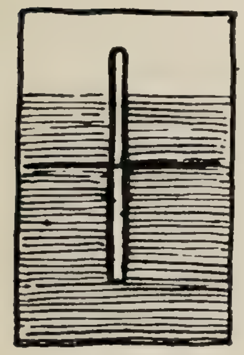


Figure 22

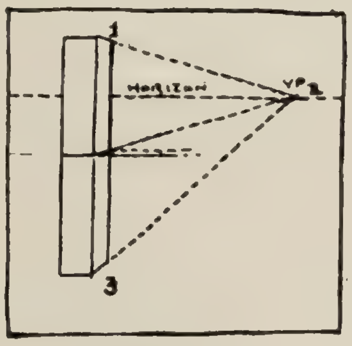


Figure 23

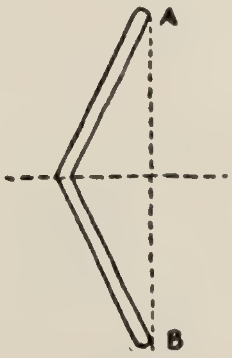


Figure 24

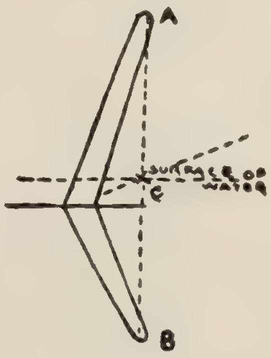


Figure 25

Figure 24 shows a post leaning to one side. The angle of the reflection is the same as the post, and a line from the top will cut the bottom of the reflection at the same point immediately below. To note this line suppose that a pebble were dropped from the top of the post. Where it would strike the water is where the reflection would end—B.

Figure 25 illustrates another position, that of the reflection of a post leaning from you and slightly to one side. Drop a stone from the top A, and where it will splash C in the water, will be one-half the distance from the top of the post and bottom of the reflection B. To find this splashing point, the perspective of the level of the water must be considered.

In the case of objects standing back from the edge of the water, we have to find where the level of the water would be at the base of the object, and repeat the height of the object from that point in the inverted reflection.

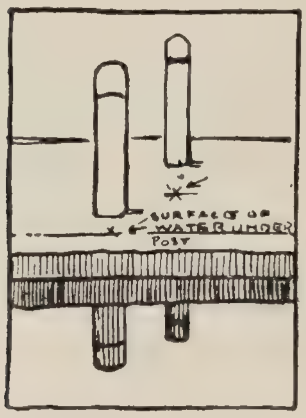


Figure 26

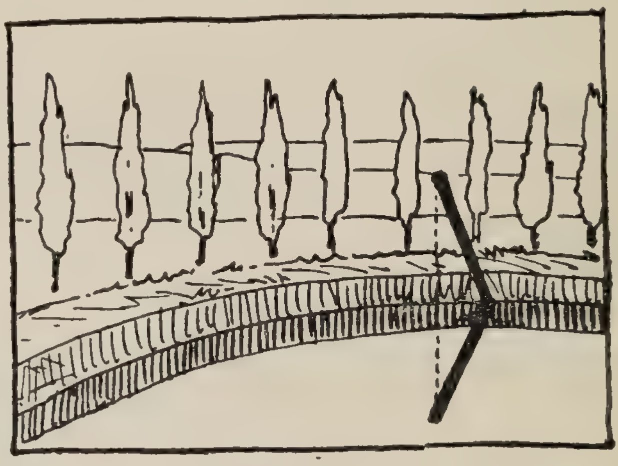


Figure 27

In Figure 26 there are two posts, one farther from the edge of the water than the other. We find the surface in the water directly under the posts, and measure the reflections from that point.

The distance of an object from the water's edge and also the level or slope of the ground back of the water must always be considered. Not everything that can be seen behind the pool will be reflected. Consider a pool of water encircled by a raised bank like a reservoir. There is a dark post leaning over the water at the edge of the pool. The under side of this will be reflected in duplicate. (See Figure 27.)

Down the slope behind the pool from where we stand we can see a row of trees. They are not reflected, because the level of the water is higher than their tops. The pool is on a hilltop. The trees are down behind, and although we can see them they cannot be reflected on the surface of the pool. (See Figure 27.)

Sometimes the under surface of another object which is not visible is reflected in the water, as the bottom of the punt in Figure 28. Observe how much of the box and the man in the boat is reflected. Their height inverted is measured from where they would rest at the surface of the water. The receding lines of the boat and the box with the lines of reflections tend to the same V.P's.

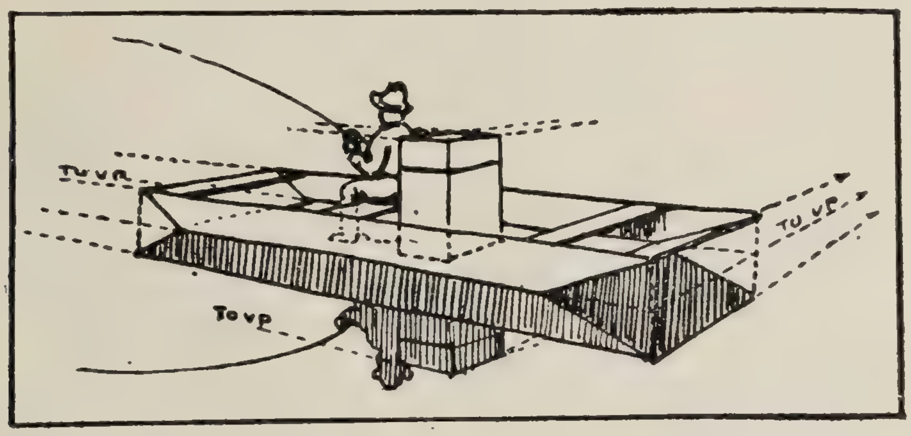


Figure 28

When the surface of the water is ruffled, the mirror-like surface is rolled into ripples which break up the reflections and cause other conditions. We are at first puzzled to account for the fact that a tree, which in calm water is reflected in an exact duplicate, in rough weather appears longer in the reflection than the tree itself on the bank. What is the cause? Figures 29 and 30 give sectional views showing how the change in angle of the surface of the water caused by waves changes the reflections.

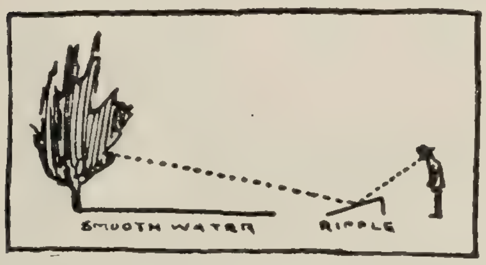


Figure 29

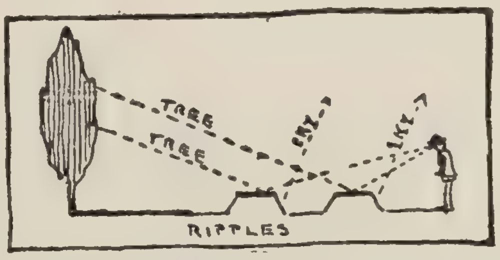


Figure 30

In the first case, Figure 29, the single wave shown is outside the ordinary range of the reflections, as indicated by the heavy line at the base of the tree. However, the angle of the wave being turned toward the tree catches the image of the tree, and reflects a portion of it back to the spectator on the shore.

In Figure 30 there are two larger waves shown, which break up the reflection, causing bars of light sky and reflection to be seen from the shore.

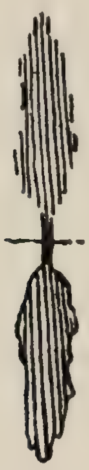


Figure 31

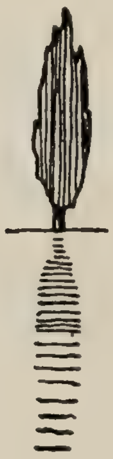


Figure 32

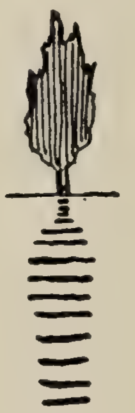


Figure 33

Figure 31 is a calm reflection, Figure 32 a slight ripple, Figure 33 a wider ripple. These three demonstrate that the greater the ripples the more will the reflection be broken up.

If one stands on a wharf between the docks and looks down into the water where there is a slight movement, he will be amazed at the number of curves, circles, and shapes of various kinds which reflect colour from every direction. It is all caused by the many angles on the surface of the restless water.

Sometimes the effect is so confusing that one would doubt whether there could be any principle which could explain the ever-changing interweaving of the colours and tones—but if he takes time to consider the angles of the surfaces and the colours of the sky, wharves, buildings, boats, etc., around, the problem will be solved.

Reflection of the Moon or Lights on the Water

In perfectly still, unruffled water the reflection of the moon will be found to be short, or a replica of the moon itself. As the water is rippled, the path of the moon will be found much lengthened, and in slightly rippled water the width of the reflection will be about the same as the light itself, and the reflections will run like a ladder of light towards the spectator.

When the water is quite rough, the angles of side waves will catch the light, and the path from the moon or lights will broaden out. The width of the streak will vary as the moon is high or low.

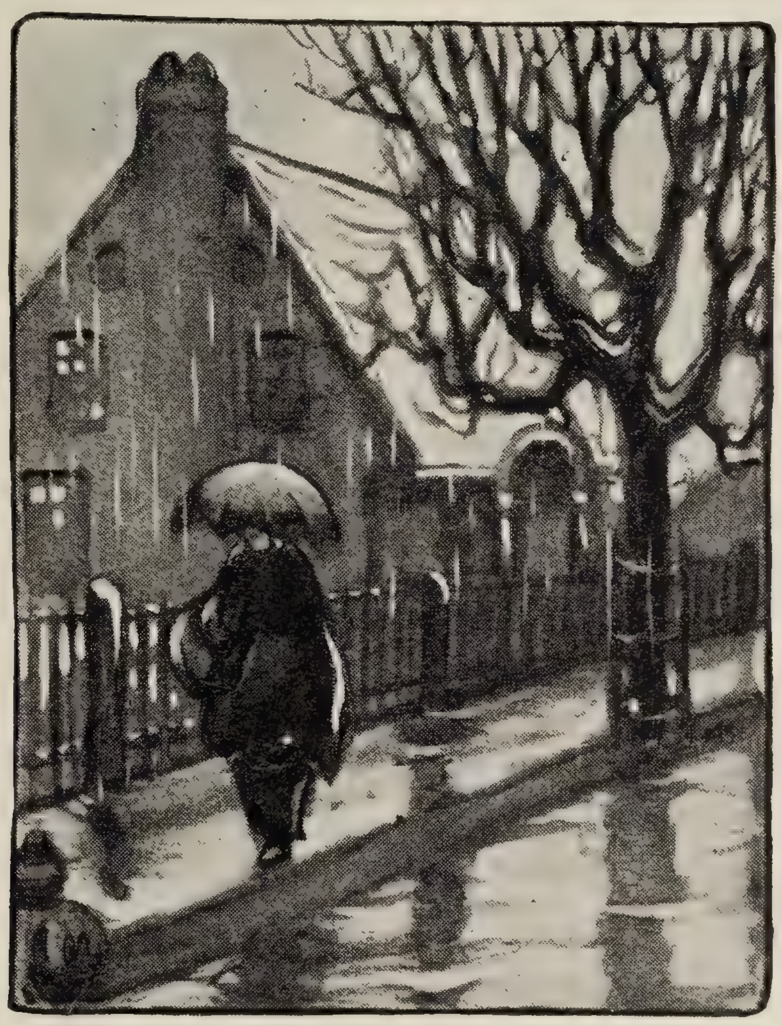


Figure 34

Reflections on a Wet and Uneven Surface

In Figure 34 we have a good illustration of the appearance and direction of reflections upon a wet paved street and sidewalk.

AERIAL PERSPECTIVE

The artist can draw or depict only the relation of one tone to another. His task is so to use lines that different parts of the subject appear, not only by their shapes, but also by their contrast of tone values, closer or farther away than others.

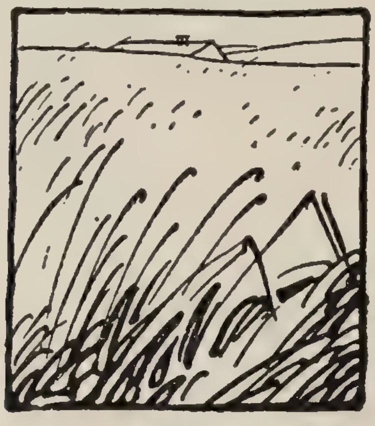


Figure 35

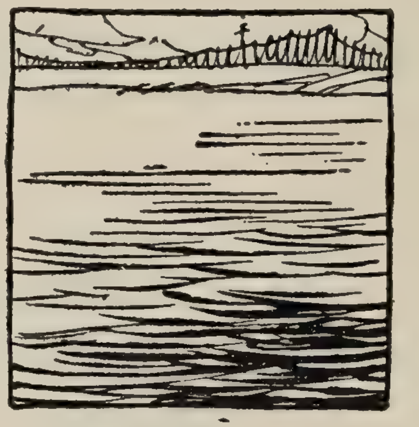


Figure 36

Figure 35 shows aerial perspective on a field of tall grass or grain. Figure 36 illustrates the same principle on water. This is one of the most important factors in freehand pen drawing, and is absolutely necessary if the drawing is to have atmosphere.

Take as an example two rows of posts receding toward the horizon. We will suppose that the posts on the left are painted *white* and those on the right are painted *black*. As we look along the row of white posts, the farther away they become the less white they appear; on the other hand, the black posts become less black and more gray, until, at a certain distance from us, there will be no apparent difference in the tone or colour of their rows. (See Figure 37.)

Figure 38 A and B illustrates the principle in squares. It is as though nature placed a screen between us and distant objects. And literally she does, for the atmosphere acts as a screen in direct proportion to the distance the object is from the eye. This principle should be made the most of, and emphasized rather than undervalued.

In proportion to the distance from the spectator a continually reduced stress should be laid upon shadows and local colour. A certain flatness is the result in distant objects.

Atmosphere plays an important function, and while a composition of close-up figures and objects may appear to have no aerial perspective, the principle holds good in practice, and is the only means whereby the elements of the composition may be simply expressed.

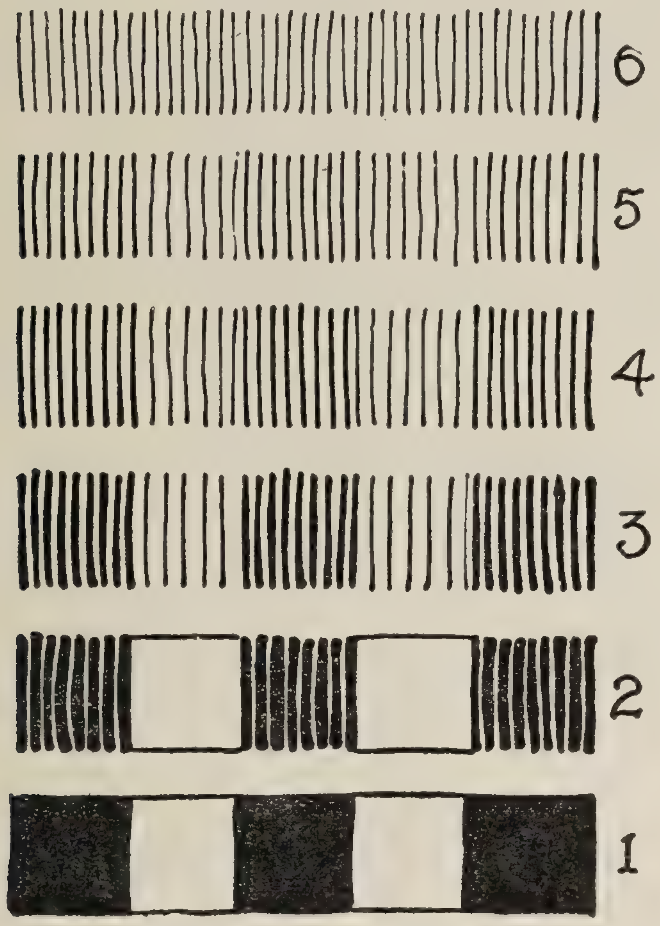
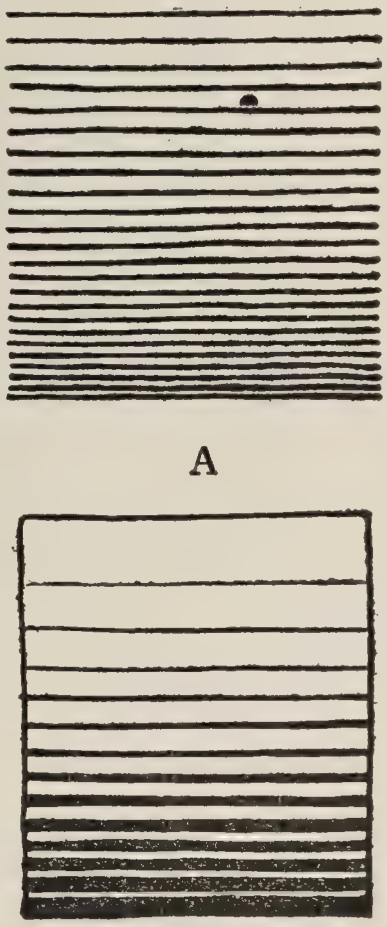


Figure 37



A

B

Figure 38

USEFUL SUGGESTIONS ON DRAWING IN PERSPECTIVE

Floor Tiling

In Figures 39 and 40 there is illustrated a method—

1. Of constructing a hexagon and an octagon;
2. Of repeating each to make a floor tile pattern;
3. Of putting the floor tile patterns in parallel perspective.

Upon *xy* the given length of each side of the required hexagon (see Figure 39), construct an equilateral triangle, making with the protractor each of the interior angles equal to 60°. With the apex *O* as a centre and *o,x* as a radius, describe

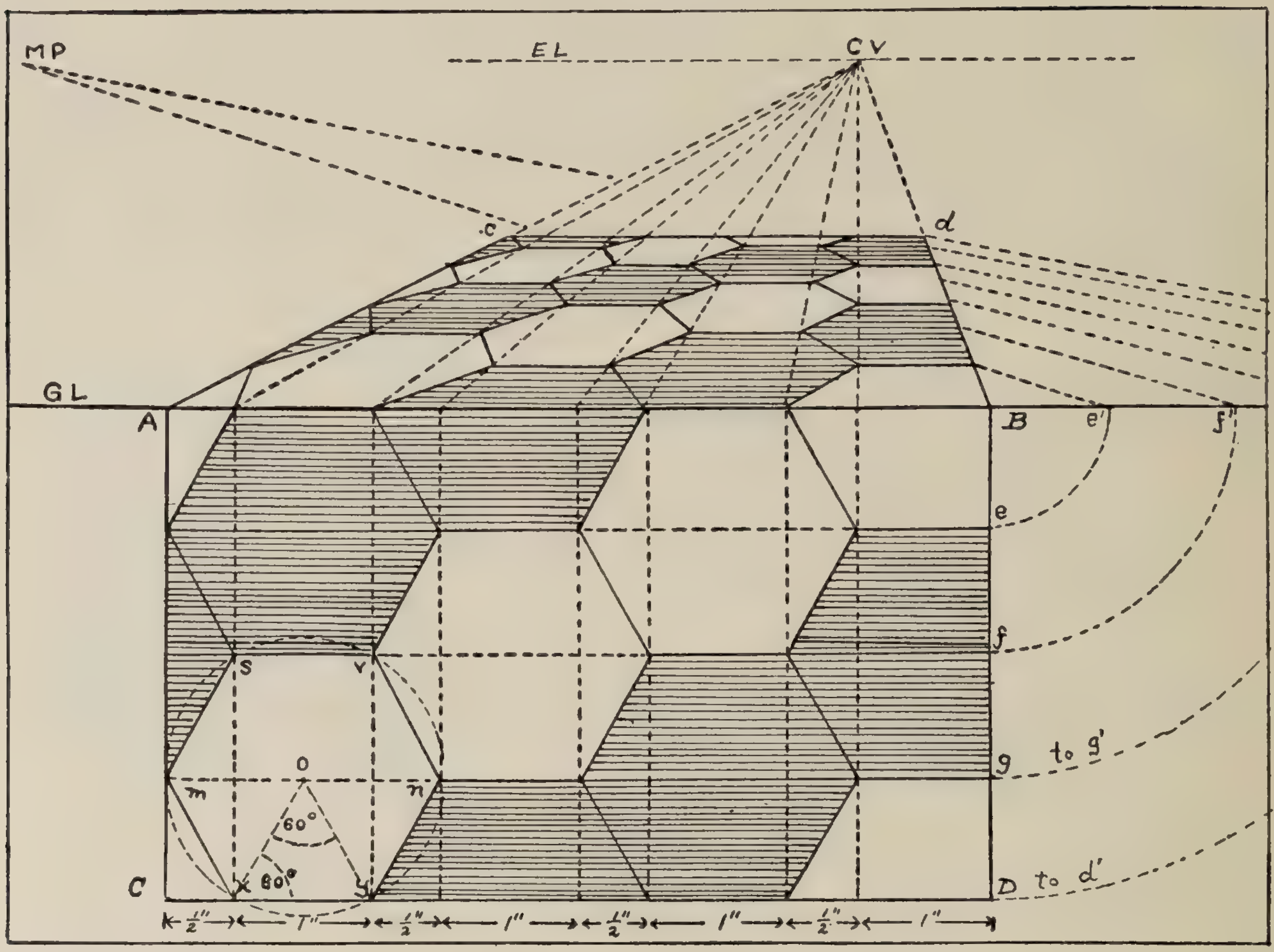


Figure 39

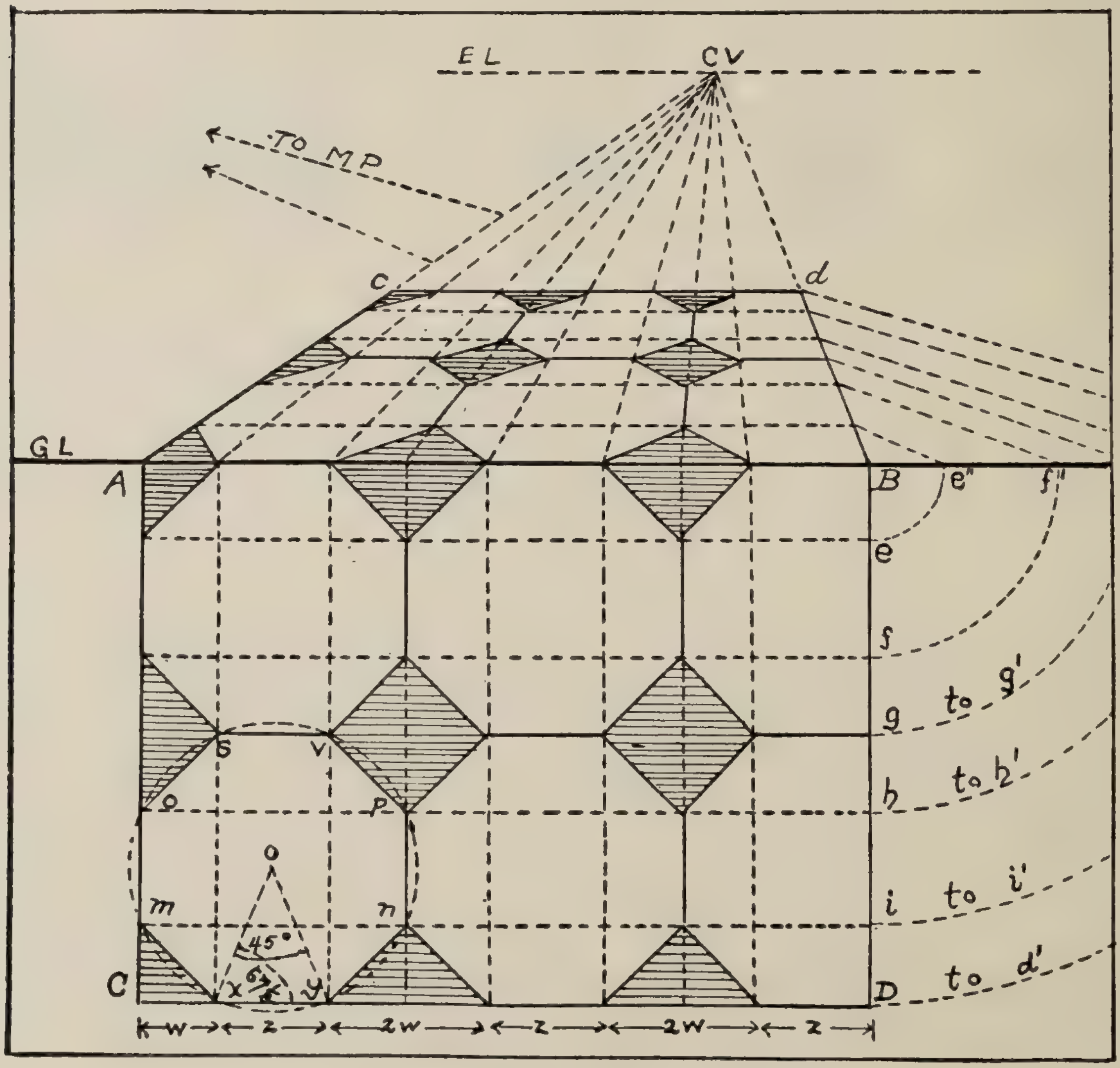


Figure 40

a circle, and repeat the radius six times around the circle, fixing the points x, y, n, v, s, m. Join these to give the hexagon $xynvsm$. As indicated by dotted lines in Figure 39, this hexagon may be converted into a plan which may be repeated indefinitely.

If it be required to place this hexagonal floor covering ABDC into perspective, treat AB as the ground line (G.L.) and extend AC and BD to any suitable point (C.V.) in the chosen eye level. The dotted lines show how the necessary points of the plan are laid out along the G.L., and, after the selection of an M.P., are transferred to the horizontal plane AB*dc*. These points are soon joined, and the perspective drawing is complete.

The appearance of the design may be varied by other arrangements of dark and light hexagons.

A similar procedure may be followed in the making of a perspective drawing of a floor showing octagonal and square tiles. (See Figure 40.)

A PERSISTENT ERROR IN PERSPECTIVE

The three drawings of a chalk box in Figure 41 provide a comparative illustration of this error. The upper drawing is in parallel perspective, the centre drawing is in angular perspective; but the lower drawing illustrates an error which recent writers on perspective, like Hatton, Taylor, Norton, and others, have pointed out.

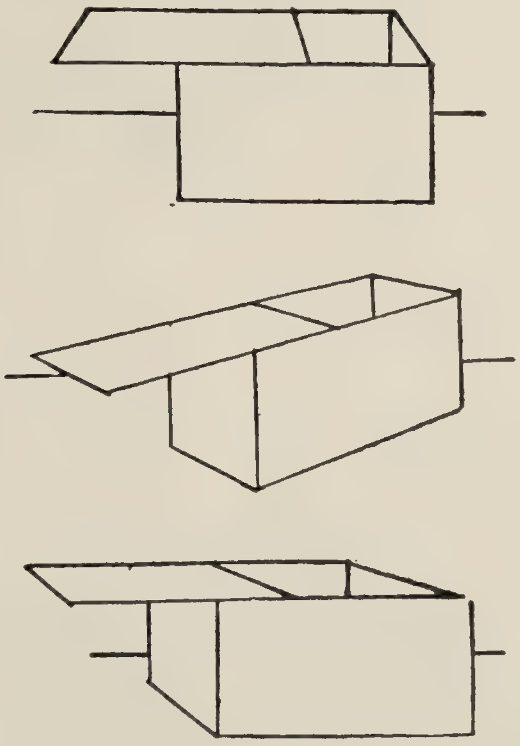


Figure 41

The houses in Figure 42 are not in correct perspective, while the perspective of the house in Figure 43 is correct. The rule may be stated thus: A chalk box (or house, or any rectilinear object) *cannot appear with front and back edges horizontal and the receding edges converging in the same direction.* On page 33 of his *Complete Perspective Course,* Spanton illustrates such a drawing as being outside the field of vision and as presenting an unnatural and distorted appearance. Hatton, in *Perspective for Art Students* (pages 20-22), reproduces some drawings to show how the old masters tried to avoid such errors, sometimes by covering them up by other details of the picture, sometimes by "the easing of the harsh effect" caused by keeping the horizontal sides of an object to the right or to the left of the line of direction strictly horizontal. This "easing" was effected by lifting from the horizontal that end of the line which ended at the "over-extended" angle.

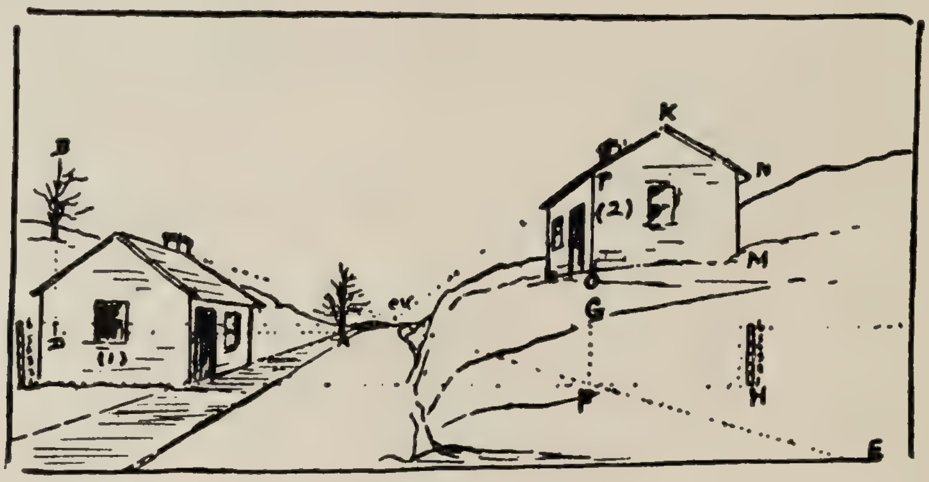


Figure 42

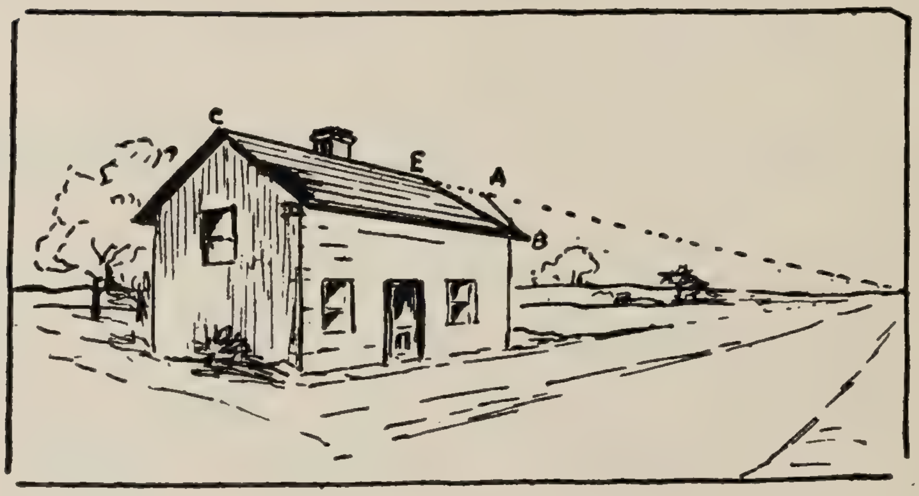


Figure 43

In Figure 44, the rectilinear Figures 1 and 3 are outside the field of natural vision, the angle at *c* is "over-extended." This distortion is corrected in Figures 4 and 6, which are in angular perspective. Figures 1 and 3 should never be described as being in parallel perspective.

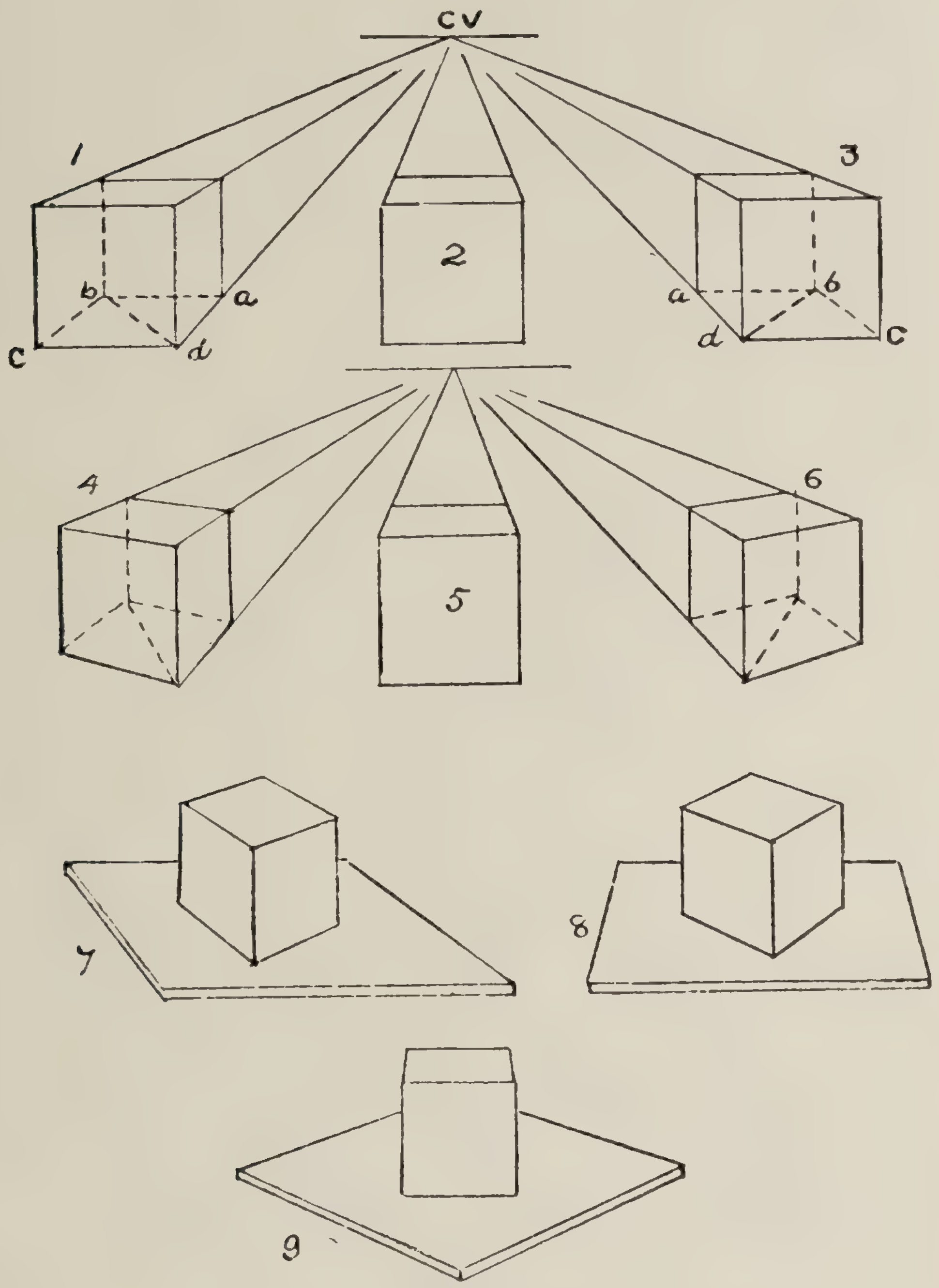


Figure 44

The following quotation from Taylor's *Elementary Art Teaching* (page 105) is pertinent: "This error has arisen from a false application of perspective, and the theory of the error has to be proved to teachers before they can believe their own eyes, and make use of them independently of their notions of perspective or not. The drawing board on which a model is placed can never appear as in Figure 44, that is, with two edges horizontal and the two receding edges slanting in the same direction. Yet for years this has passed as right in examinations and in finished drawings in light and shade."

An Apparent Inconsistency

A modification of this law must now be indicated and explained.

In Figure 45 the interior of a room is shown in parallel perspective, with a table to the left and a chair to the right of the line of vision. These pieces of furniture are placed parallel with the receding lines of the room; hence, to *look right,* their front edges must be drawn parallel with the picture plane. If, for example, the horizontal lines of the table were eased off to the left, the table would *look wrong.* (See Norton's *Freehand Perspective,* pages 132-142.)

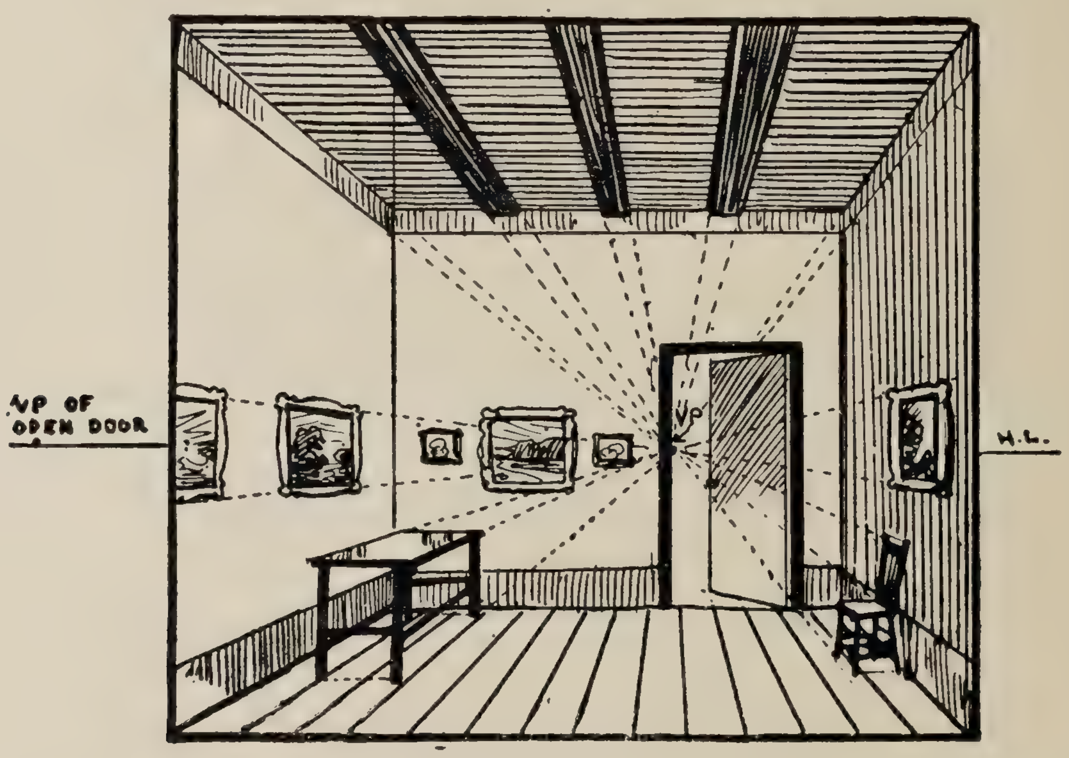
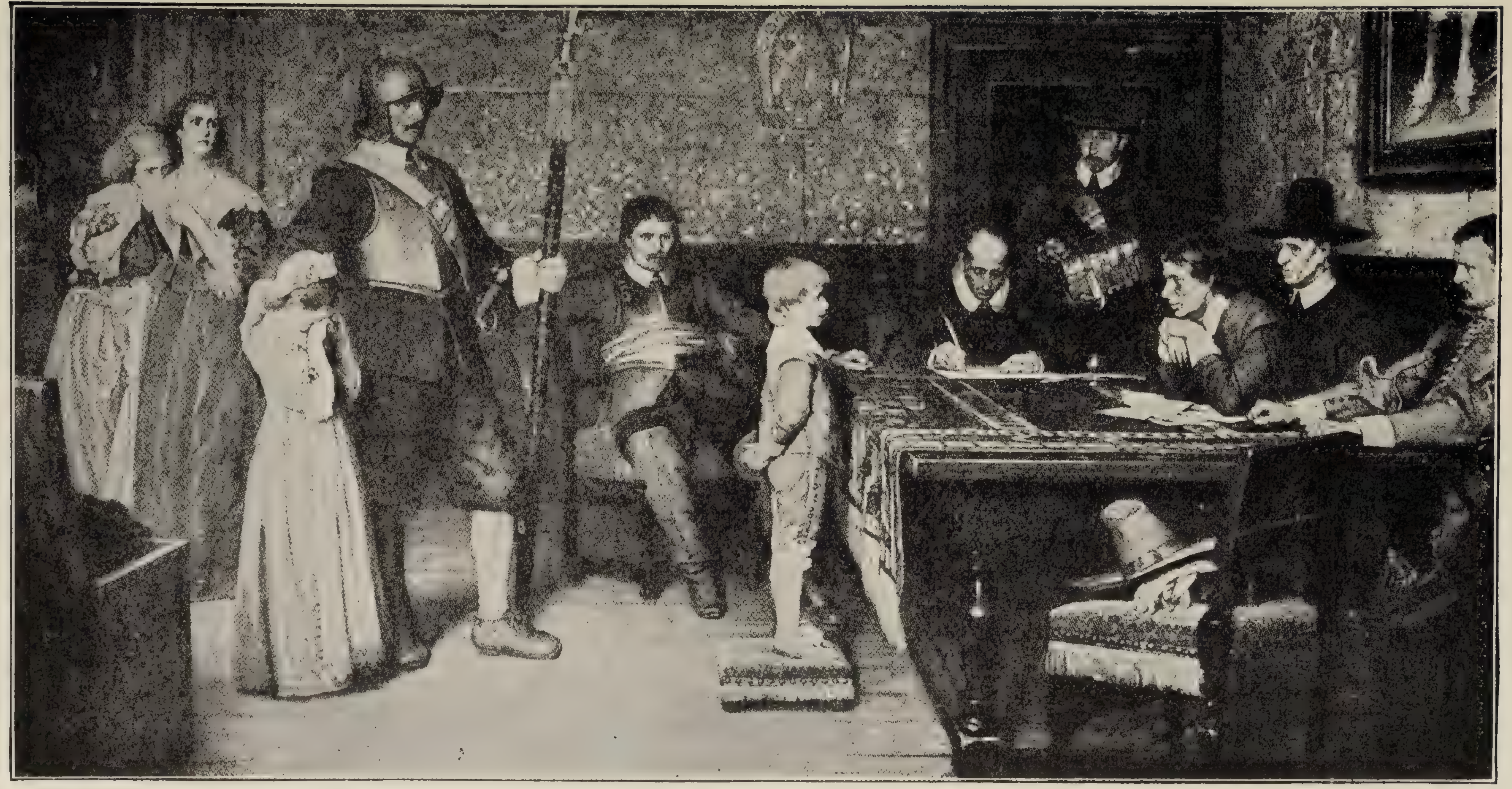


Figure 45

Examine the perspective of the table in Figure 46 as a further illustration of this exception to the rule.



W. F. Yeames, R.A. AND WHEN DID YOU LAST SEE YOUR FATHER ? *Walker Art Gallery*

Figure 46

APPLICATION OF THE LAWS OF PERSPECTIVE TO PICTURE STUDY

A careful examination of the perspective of a picture will reveal beauty of design, careful drawing, and technical skill of high order.

Sometimes an unsuspected and unjustifiable carelessness and a consequent marring of an otherwise meritorious composition will be discovered. Walter Crane speaks of outline as the Alpha and Omega of art. When the outline becomes involved with the third dimension, greater care must be taken. The artist who, in addition to the numberless other qualities he puts into his work, watches closely the perspective of his drawing, the eby enhances the beauty and consequent enjoyment of his art; neglect of this, in spite of clever, colourful, artistic rendering in other respects, will cause its depreciation.

NOTE:—Some of the pictures named below are inserted for the convenience of the students. See pp. 41-48.

The student should examine pictures in art galleries, in books and magazines, and in his own collection of masterpieces, with such questions as these in his mind:

1. Where is the eye level in the picture?

   How can it be located accurately?

   Where is the centre of vision or where are the vanishing points?

   Has the location of the eye level any effect upon the sentiment expressed by the picture?

   See *Yeames*—And When Did You Last see Your Father? (Fig. 46)
   Leighton—Captive Andromache (Page 45)
   Alexander—Isabella, or the Pot of Basil
   Da Vinci—Last Supper
   Velasquez—Maids of Honour
   Tintoretto—Transportation of the Body of St. Mark

2. Are there cast shadows in the pictures?

Do they indicate the source, the character, and the direction of the light?

Do they indicate the time of day?

What do they add to your enjoyment of the picture?

See the previously named pictures and
Poynter—Faithful unto Death (Page 41)
Rivière—The Hunter Hunted (Page 43)

3. Are there any reflections in the picture?

In what respects are they like or unlike the object reflected?

Compare the length, the direction, and the distinctness of the reflection with the object reflected.

See *Turner*—Fighting Téméraire
Constable—Bridge on the Stour
Martin—Harp of the Winds
Durham Cathedral (Page 47)

PROBLEMS FOR PRACTICE

1. Draw an angular perspective diagram to illustrate the fact that the same angle will vary in appearance at different levels and at different points on the same level. (See Figure 1.)

2. Make a drawing of a building in perspective, using the ground plan, and front and side elevations given in Figure 47. Place a chimney as indicated in the back corner of the ground plan, the height of which is shown at the side of the front elevation.

Use a 10″ horizon line and place the building in about the same position and angle as Figures 2-5 and 6-8. Read carefully the methods of drawing a perspective from the ground plan explained and illustrated in these pages and Figures.

3. Draw a plan, front and side elevation, of a small school-house with bell tower on top of porch or front entrance.

Make a projection of these to show a pictorial rendering of the school-house in angular perspective. (See Figures 6-8.)

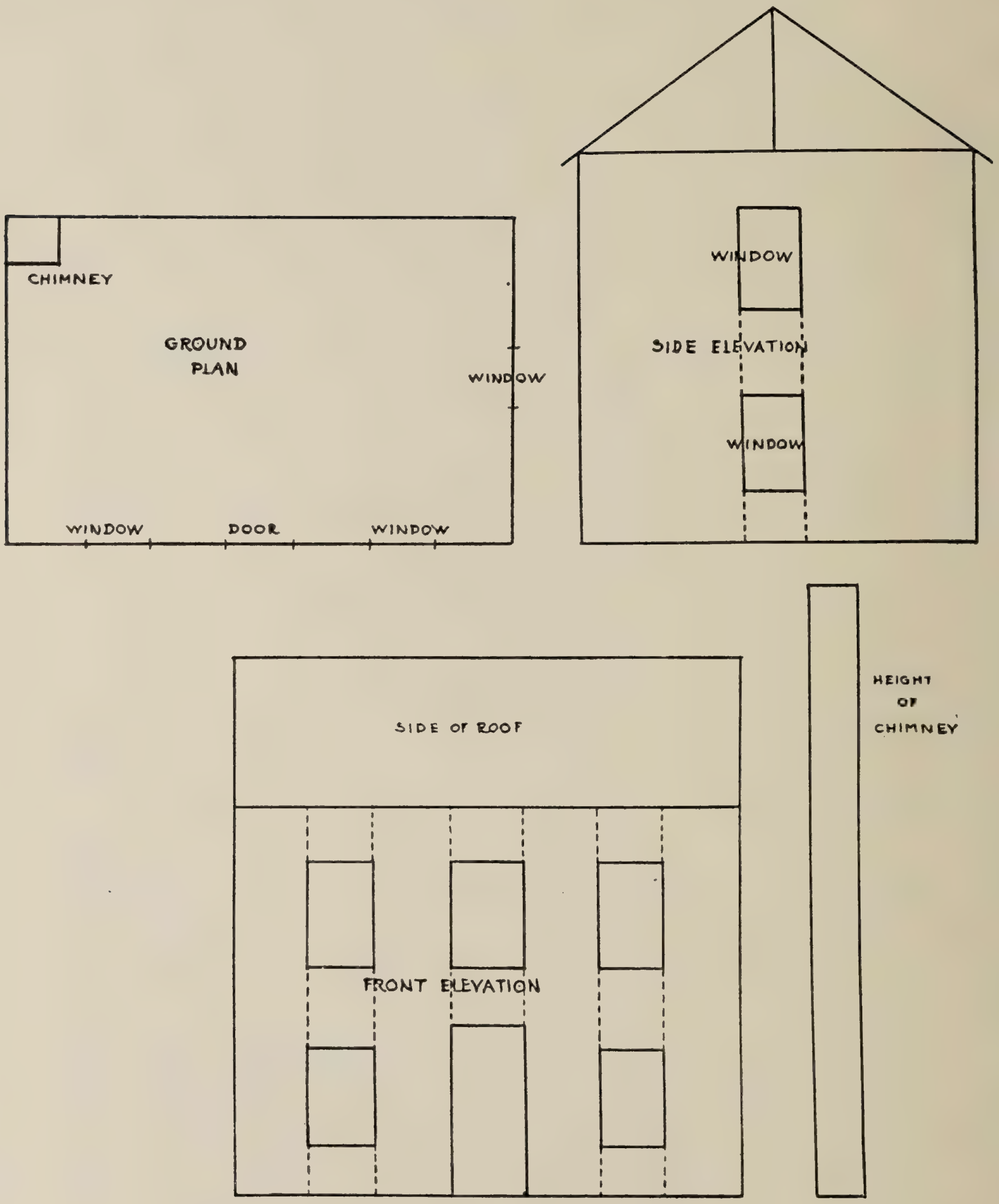

CHIMNEY
GROUND PLAN
WINDOW
WINDOW
DOOR
WINDOW
WINDOW
SIDE ELEVATION
WINDOW
SIDE OF ROOF
FRONT ELEVATION
HEIGHT OF CHIMNEY

Figure 47

4. Draw at right angles to the picture plane a rectangular piece of board represented in the drawing by a plane 1″ high and 2″ long.

Show the appearance of the shadow cast by this board—

(1) When the light is artificial and shining from the upper left-hand side of the board.

(2) When the light is from the sun shining similarly from the upper left-hand side of the board. (See Figures 12 and 13.)

5. Draw the appearance of the shadow cast by the same board—

(1) When the sun is shining from above and behind it. (See Figure 14.)

(2) When the sun is shining from above and in front of it. (See Figure 19.)

6. Draw a diagram with a cube in angular perspective, to illustrate the law governing the shape of cast shadows. (See Figure 15.)

7. Set up in a strong light a chalk box at an angle with the picture plane and with the lid half drawn to the left. Have the light descending from a position to the upper left of the box.

(1) Draw the box as seen.

(2) Carefully express the cast shadows.

8. Arrange and draw the following group of models:

A square plinth at an angle with the picture plane, a small sphere upon the plinth, a cylinder also at an angle with the picture plane to the right of the plinth one corner of which touches it about the centre. (Real objects may be substituted.)

Draw this group and carefully place the cast shadows when the light comes from the upper left front. (The principles involved are illustrated in Figures 17-21.)

9. Finish the drawing required by Question 6 (see Figure 15) to illustrate the principle of reflections. What is meant by the *angle of incidence?* The *angle of reflection?*

10. Draw a square post represented in the drawing by a stick-like form 2″ high, also draw its reflections upon a reflecting surface—

(1) When standing upright. (Figures 22 and 23)

(2) When leaning slightly to the left and away from the spectator. (Figure 25)

(3) When leaning slightly to the right and towards the spectator. (Figure 24)

Show the same post and its reflection off and back of the reflecting surface. (Figure 26)

11. Draw a poplar tree and its reflections, when growing beside water—

(1) When the water is calm. (Figure 31)

(2) When the water is rippled or rough. (Figures 32 and 33)

12. The moon has risen about an hour over the lake. Draw it and its reflection in the water—

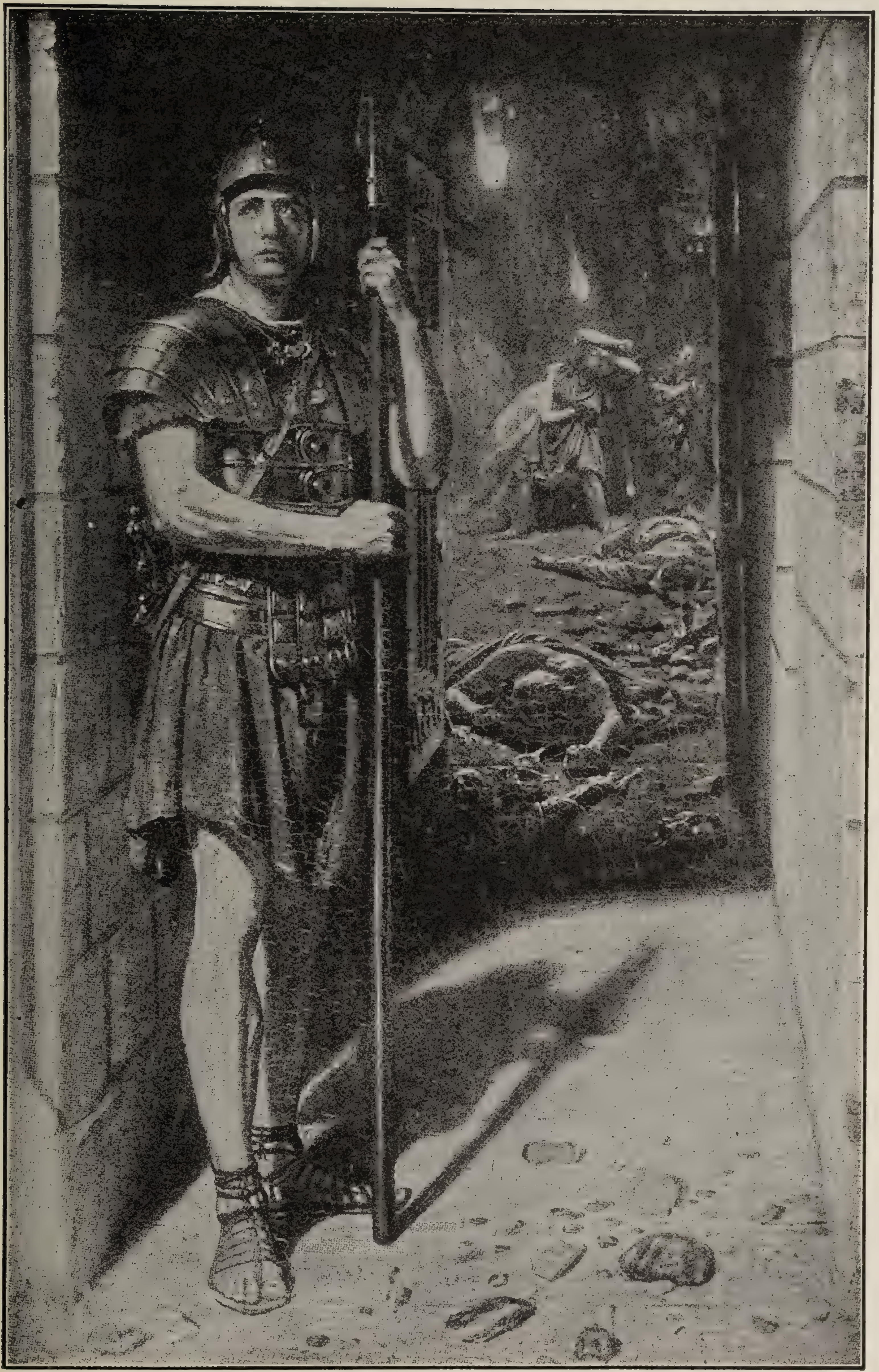
(1) When the water is perfectly calm.

(2) When the water has been fanned by the wind into ripples.

13. According to the principles of aerial perspective, as illustrated in Figures 35-38, make a drawing of some interesting scene.

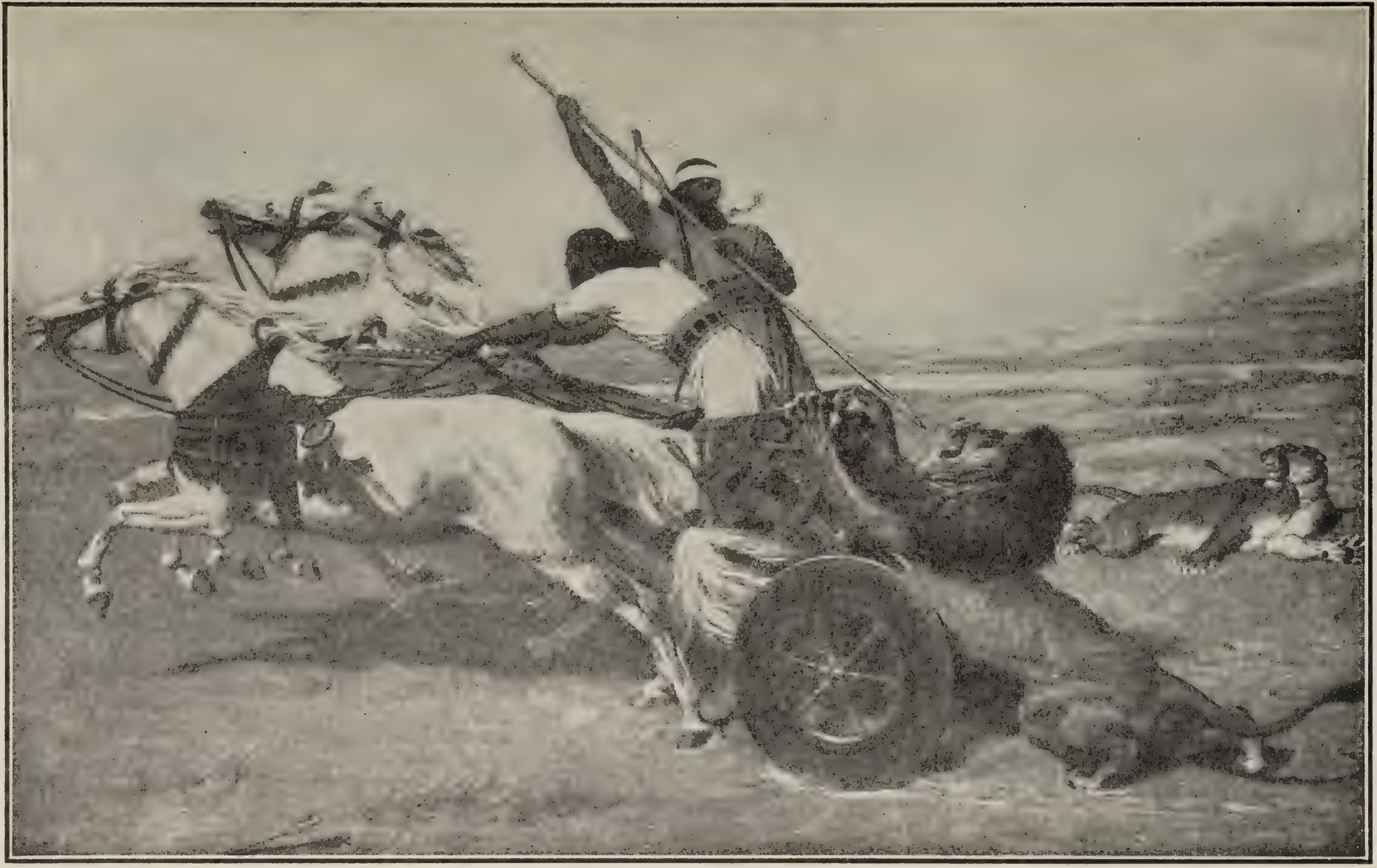
14. Draw a room like that in Figure 45 in perspective, and draw hexagonal (or octagonal) tiling on the floor. (Figures 39 and 40)

15. What is wrong with this problem? Draw in parallel perspective a rectangular form like a cube, below the eye level and to the left of the line of vision, so that a good view may be had of the right side as well as of the front and top.



Sir E. J. Poynter, P.R.A. FAITHFUL UNTO DEATH *Walker Art Gallery*

Figure 48

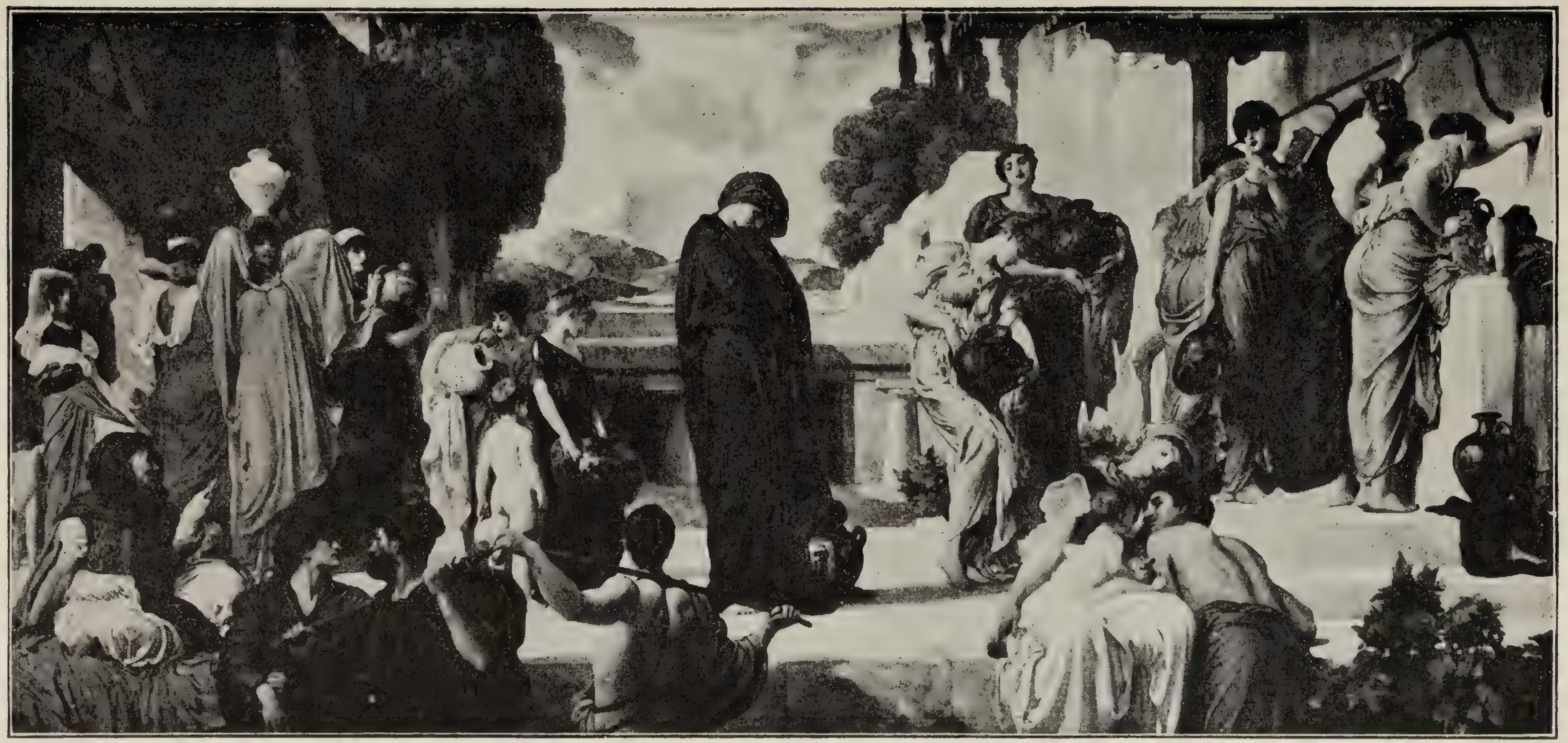


From the painting by
Britton Rivière, R.A.

THE HUNTER HUNTED

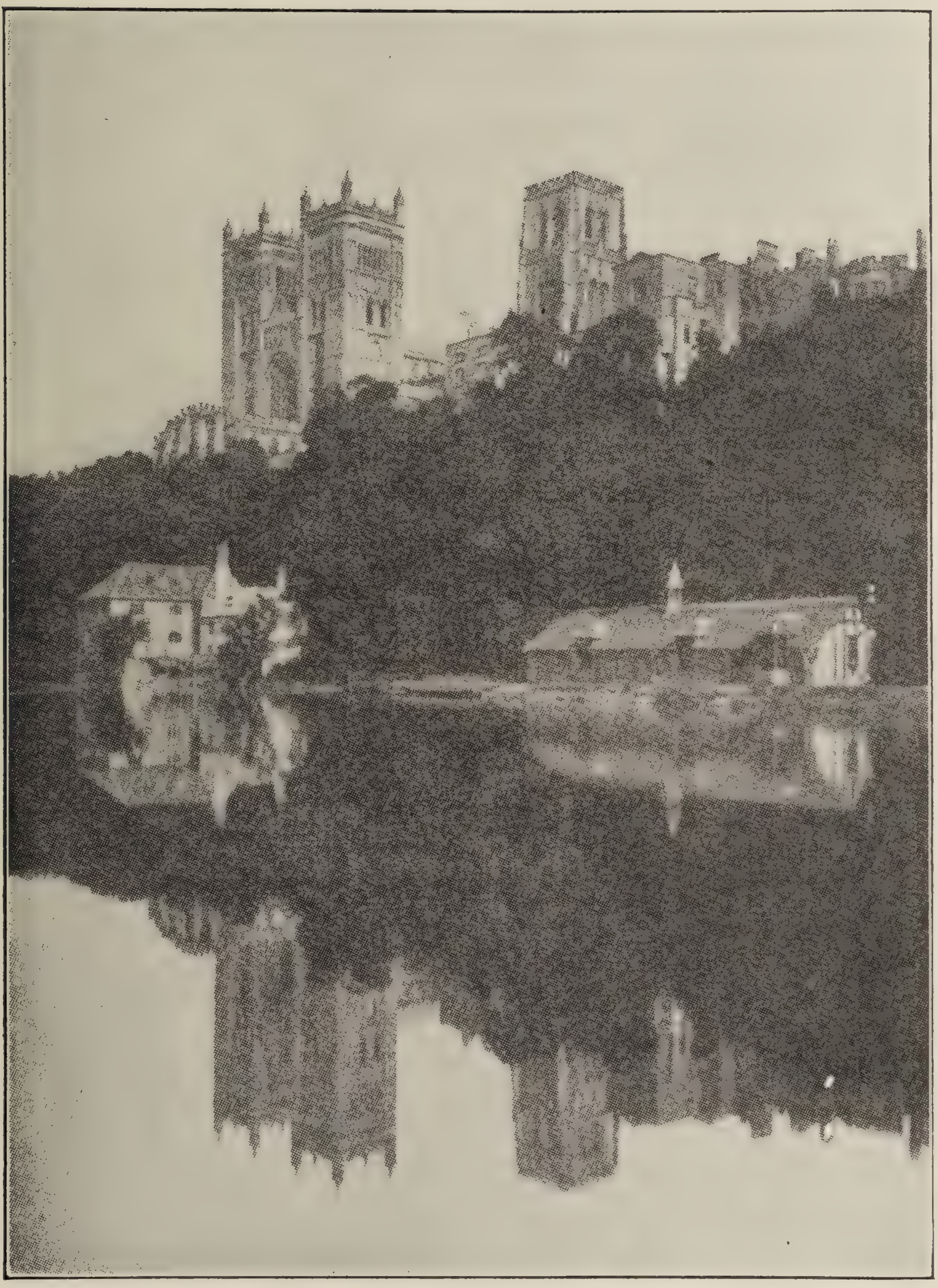
Figure 49

In the Manchester
Whitworth Institute



Sir Frederick Leighton, P.R.A.

CAPTIVE ANDROMACHE



DURHAM CATHEDRAL *Perry Pictures*

BIBLIOGRAPHY

For a review or for further study of the subject of perspective, the following books or portions of them are recommended:

1. Perspective for Art Students. (Projection of Shadows, Reflections, Problems. Pages 142-266.) R. G. Hatton. Chapman and Hall, London, England.
2. Freehand Perspective and Sketching. D. M. Norton. Published by the Author, Pratt Institute, Brooklyn, U.S.A. This work is accurate, readable, well illustrated, and very helpful throughout.
3. Art Education for High Schools, Part II. The Prang Educational Company, New York. There are about 40 pages of finely described and illustrated problems in freehand and in mechanical perspective.
4. Applied Art. Pedro J. Lemos, The Pacific Press Publishing Association, Mountain View, California, U.S.A. Pages 221-224 and 236-241 deal with perspective in a very simple and interesting way. Every teacher should possess this book for the numerous suggestions and clear explanations which it gives on very many parts of the Course in Art.
5. Complete Perspective Course. J. H. Spanton. The Macmillan Co., Ltd., Toronto. The first 47 pages of this work are elementary. The rest of it is quite advanced.
6. Perspective and the Making of Pictures. Vicart Cole, $4.50. Pitman.
7. Elementary Art Teaching. E. R. Taylor. Chapman and Hall, London, England.